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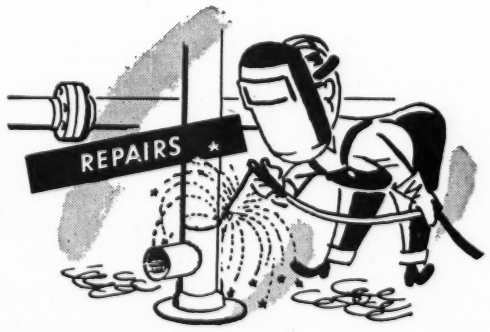

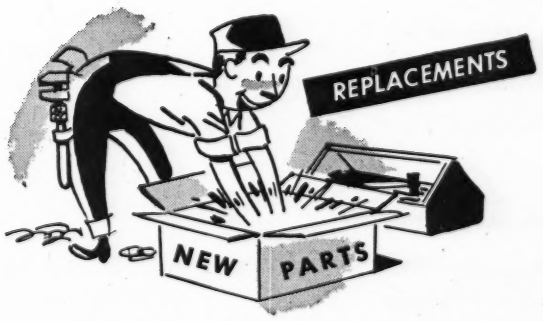

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29th Year of Publication

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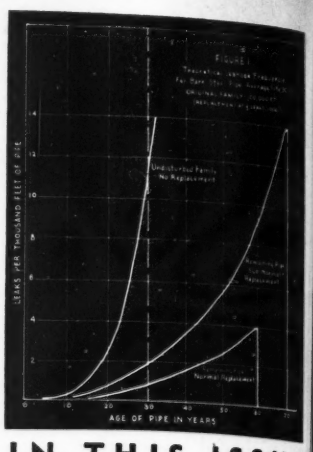

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Exponential increase in number of pipeline leaks with age, and bearing it has upon distribution system maintenance is described on page 33.

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Thermally Thinking

SPOT NEWS AND COMMENT ON GAS INDUSTRY AFFAIRS

Highlighting the News

Watch the water heaters go by

Water heaters continue to lead the base load gas appliance parade. July's shipments of 173,000 units topped July 1952's total of 131,300 by 31.8%. For the seven months of 1953, 1,306,400 had been shipped, representing a boost of 24.8% over the 1,046,700 units shipped in the like period of 1952.

Trouble at Herscher?

Pumping of gas into Herscher Dome storage field near Kankakee, Ill., was halted last month for test when it was reported that seepage of marsh gas from old water wells in the vicinity had increased. Although there was no indication that the phenomenon had any connection with Herscher operations, Peoples Gas Light's storage subsidiary decided to undertake the extensive checks.

Analyzer for Columbia

Another distribution network analyzer (Laclede recently installed one—see *GAS*, August, page 27) is being installed by the Columbia Gas System at Columbus, Ohio. Public Service Electric & Gas (Newark) is scheduled to be the next customer.

Warm winter in Brooklyn

Brooklyn Union Gas Co. is confident that it will attain its goal of 10,000 new househeating installations before the year is out. At half-time, 4153 had been installed compared to 4059 for the entire year 1952.

Common carrier bill okayed

President Eisenhower has signed the common carrier bill, which removes a long-standing pain from the neck of the gas industry. The measure very sensibly recognizes that gas pipelines, by their peculiar nature, cannot provide transportation service to anyone who applies and still carry out their primary function of providing continuous fuel service to specified customers.

33 states defend tidelands

By mid-August, 34 states had joined up to oppose Arkansas' lawsuit to have the state tidelands ownership law declared unconstitutional. Only three attorneys general voted against the resolution offered by Texas' John Ben Shepperd. Six others said they lacked authority. Atty. Gen. W. E. Howers of Rhode Island said he would file suit to test the law's validity.

Easing a shortage

Michigan Consolidated Gas Co., Detroit, had some of its interruptibles cut off by the state PSC last month in a move to ease gas shortages. Although there's still no prospect for lifting restrictions on househeating (said PSC), they may be modified. A billion feet per month was ordered diverted from interruptible customers to general system use, and to storage. MichCon was directed to add no new customers using less than 5000 ft per month.

Gas for petrochemicals "not natural"

Panhandle Eastern has won an FPC presiding examiner's nod to serve its affiliate, National Petro-Chemicals Corp., interrupible gas up to 7 MMcf per day for fuel. However, gas that will flow through the plant for stripping of ethane and heavier hydrocarbons is "not a sale of gas under the Natural Gas Act" and thus not subject to jurisdiction, Examiner Farrington ruled, rejecting an FPC staff contention to the contrary.

An Eye on the Capital

FPC flopover

For the first time since last Jan. 20, when the new President took the helm of the ship of state, the administration now has a Federal Power Commission more or less amenable to the hopes and aims of that administration.

With the confirmation of Seaborn Lee Digby, 61, a former conservation commissioner of Louisiana and a "Democrat-for-Ike" in the 1952 election, the FPC now has its full quota of three Republicans and two Democrats, with one of the Democrats, Mr. Digby, being that in name only. The only other Democrat on the commission is Dale E. Doty, who had worked his way up through the New Deal bureaucracy to be a big wheel in the Bureau of Reclamation before last year getting appointed to the FPC by Truman.

Chairman Jerome Kuykendall, after a study period in which he apparently has sized up both Washington and the scope of his job, has moved in several ways to indicate that the FPC is not going to be antipathetic to the natural gas business and to other industries under its federal regulation.

The FPC has invited 12 gas industry leaders to meet here on Sept. 16 to discuss the possibilities of an industry advisory group to study the various regulatory problems confronting the FPC and the industry. This is tacit admission by the FPC that such an advisory group is long overdue.

"This is a great step forward," one industry executive commented here. "It proves that there is a new feeling toward the natural gas industry—and toward all industry—in the federal gov-

Thermally Thinking

ernment. We welcome this, although it is long overdue. PAD long ago proved the utility of industry advisory groups, and particularly in the utility field."

Incidentally, the Department of Commerce has adopted the idea of continuing industry advisory groups over into peacetime, and, in fact, these are being expanded by that department. It's felt that this is a wonderful way for government administrators to find out what businessmen are thinking at the grassroots.

There is a danger, however, in having such industry advisory committees working closely with the men who are supposed to be regulating the industries, some cautious observers here have pointed out. Whenever anything goes wrong, citizens who are opposed to the ruling can always charge that the industry had "undue influence" with supposedly impartial public administrators. In the hands of certain writers and columnists, such a set-up can be made to seem very dangerous and inimical to the interests of the people. Yet, even with this apparent propaganda danger facing them, the members of the gas industry still hail this move toward great government-industry cooperation.

News?

Solomon said that there's "nothing new under the sun," but he couldn't have had advance warning of the "New Newspaper Service," which is a feature of the Washington scene these days—and one that isn't likely to be blessed by the natural gas industry, or any other privately owned facility.

The "New Newspaper Service" is a creature of the International Typographical Union. Several years ago, the ITU dipped into its "defense fund"—gathered from good union members to protect others on strike—and began forming rival daily newspapers in cities in which it felt that it could compete with the existing dailies. Several months ago, in order to give these ITU-owned newspapers a Washington Bureau all their own, and also in order to "cover" developments in the union's own unique way, the ITU founded the "New Newspaper Service." It has all of the ITU-owned newspapers as clients, and some others that are very sympathetic to the cause of the ITU and union labor generally.

Gas Rate Bill To Be Revived At Next Session

WASHINGTON (NNS)—A bill to weaken consumer protection against increased natural gas rates will be the first order of business at the next session of the 83d Congress in January.

An attempt to sneak the measure through in the closing days of the first session ran into a last-minute block by Sen. George Smathers (D-Fla.)

The bill, which would strip Federal Power Commission protection on rates from states distributing gas within a state, was rushed through the House and sped through the Senate Commerce Committee on greased skids without hearings.

But when it came to the Senate floor on a calendar call Smathers objected and the measure [illegible] the next session.

This is news? NNS stands for "New Newspaper Service," a union-controlled "news service" whose "news stories" are short on news, long on opinion.

The aim of a reporter, or writer, for the "New Newspaper Service" is not to give facts, and let them fall where they may, hurting or helping as the case may be. They are "sold" on an idea in advance as to how things ought to be, and many of their "news" stories are nothing but inaccurate news editorials labeled as news stories.

There are two sides to every story, and a thousand sides to many stories, depending upon the circumstances, but you will never see but one side in any "news" stories peddled by "New Newspaper Service." That is the ITU side. If you want to know what the ITU believes, just write to its headquarters in Indianapolis, Ind., and get the dope. It's generally against every effort to cut down the federal establishment, to leave a profit to any business, and to keep anybody except "liberals" in office. The "New Newspaper Service" follows the ITU party line as faithfully as the Washington correspondent for the *Daily Worker* follows the Communist Party Line.

Bricker is good news

The selection of Senator John W. Bricker (R.-O.), as chairman of the Senate Committee on Interstate and Foreign Commerce was hailed generally in natural gas circles here, since Senator Bricker, as Governor of Ohio and since being in the Senate, has given every evidence of being fairminded toward utility management, a marked contrast to the attitude of his predecessor, the late Senator Charles W. Tobey (R.-N. H.).

Senator Bricker did something near the end of the session that Senator Tobey never would have done. When the House passed by voice vote the Hinshaw Bill (H. R. 5976) to amend the Natural Gas Act so as to relieve intrastate gas distributors from FPC jurisdiction (given to the FPC in the East Ohio case in 1950), Senator Bricker saw to it that the legislation was quickly reported out of his committee. Mr. Tobey would have killed the legislation by delay. As it was, the Hinshaw legislation was stalled by objection of Sen. George Smathers (D.-Fla.). It was called up out of order, that is, unscheduled, and could pass the Senate in the closing days only by unanimous consent. Sen. Smathers' objection killed it. Mr. Smathers is the so-called conservative who won out over Sen. Claude (Red) Pepper (D.-Fla.) three years ago, but Mr. Smathers, other than talking conservatively, doesn't vote very differently from the manner in which Mr. Pepper voted.

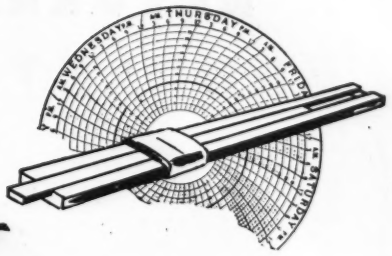
Incidentally, labor union newspapers had a field day describing how the Hinshaw Bill was "railroaded" through the House and almost through the Senate. They blamed the haste on a sinister "natural gas trust," although the bill has been in the House hopper for some months and there never has been any secrecy about the desire of intrastate companies to get out from under FPC jurisdiction since 1950.

Chuck out the "bare bones"

The natural gas industry has hailed without equivocation Federal Power Commission's first rate decision in re

Continued on page 56

Technical Trends



• By GUY CORFIELD

A philosophy of telemetering

Dr. Jesse E. Hobson, director of Stanford Research Institute, delivered a thought-provoking address entitled "A Philosophy of Telemetering" before the May 1953 National Telemetering Conference at Chicago. Telemetering, "the art or science of measuring at a distance," is widely used in the gas industry and in other industries and activities concerned with operations occurring at widely separated points, and involving numerous variables, such as pressure, temperature, movement and position, which it is desirable and sometimes imperative to coordinate and control rapidly and accurately from a few central points. These points might be a gas dispatcher's or station operator's desk, the control room of an oil refinery or chemical plant, the control tower of an air flight research field, or the possible future traffic centers directing space travel.

It is obvious that telemetering, as applied to such types of operations, will become more and more widely used and complicated, and it was with this in mind that Dr. Hobson developed his philosophy. He explained the advent of telemetering as arising from man's need and ingenuity for extending the perception and reception of which the human body is capable. "A telemetering system," he said, ". . . tells what is taking place at points we may not be able to see, what sounds are occurring which we cannot otherwise hear, what temperatures are being created which we cannot feel, and what is happening outside the direct-measuring ranges of our senses. A thermocouple may take the place of a sensing finger; a radio link may do the work of a nerve tract; a radio receiver may substitute for the brain in accepting the telemetered signals, and computing devices perform the mental interpretation and decision-making operations."

He brings out the point that the facilities to transmit information already exceed the comparable means of receiving and utilizing it, with the ability of the human mechanism lagging behind both. "The point is being reached where in the overall system the weakest link may be the human operator. Almost any complex telemetering system produces, or is capable of producing, so much information that even with the aid of electronic data-handling equipment, the human mind cannot always react with sufficient speed, accuracy and reliability . . . We must, wherever possible, 'bypass' dependence on man as a link in the telemetering network. The goal is to carry the telemetering information automatically beyond the evaluation stage to decision and action."

Dr. Hobson's philosophy emerges from these considerations:

"If we accept the idea that an objective of telemetering in the past has been to extend man's native telemetering function over greater and greater distances and ranges with ever-increasing accuracy, then perhaps we may have created the basis for a new philosophy in the future. The change may be from the 'art or science of measuring at a distance' to 'the science of measuring, and *acting* on these *measurements automatically,* without human assistance.' The philosophy is easily stated, but the scientific problems are not easily solved. I have no doubt that solutions will be found."

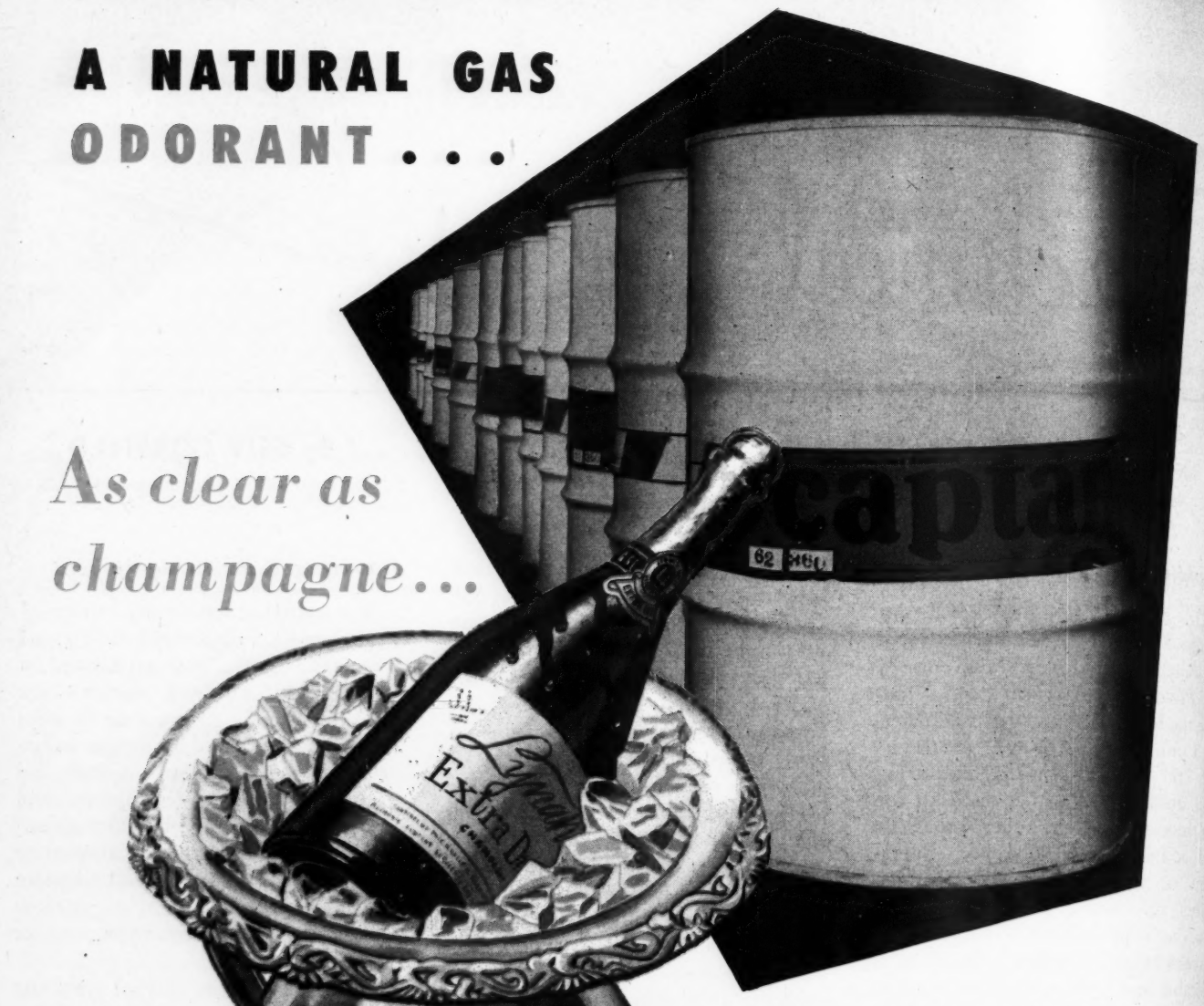
Detecting leaks in equipment

The analytical service department of Consolidated Engineering Corp. of Pasadena, Calif., has established a "custom leak detection service"—not for the detection of the kind of leaks ordinarily considered by the gas industry, but for leaks in pressure and vacuum equipment, development and pilot models, special laboratory assemblies, etc. The department claims to be able to detect a leak, from atmosphere into an evacuated system, as small as 10^{-9} cc per second, equivalent to 1 cc in 31 years.

The principle is that of detecting helium by use of a simplified portable mass spectrometer sensitive to traces of this gas. This general type of service has been available for some time for plant use in checking pressure or vacuum vessels, whereby the vessels are pressurized by a helium-air mixture and leaks are explored for by a probe attached to a suction line leading to the mass spectrometer, which detects any helium picked up by the probe; or the vessels are evacuated in an external atmosphere of helium-air and a suction line from the interior to the instrument will indicate leakage.

In this newly instituted service the apparatus is sent to the Consolidated laboratories where examination will be made at a flat fee. A 10-port vacuum manifold has been developed so that nine samples can be tested at one time and the rate of leakage compared to that of a "standard leak." This inspection not only determines the existence of any leaks, but indicates their rate and their exact location. Obviously this method is non-destructive and non-contaminating.

A NATURAL GAS ODORANT . . .



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A management view of distribution system maintenance

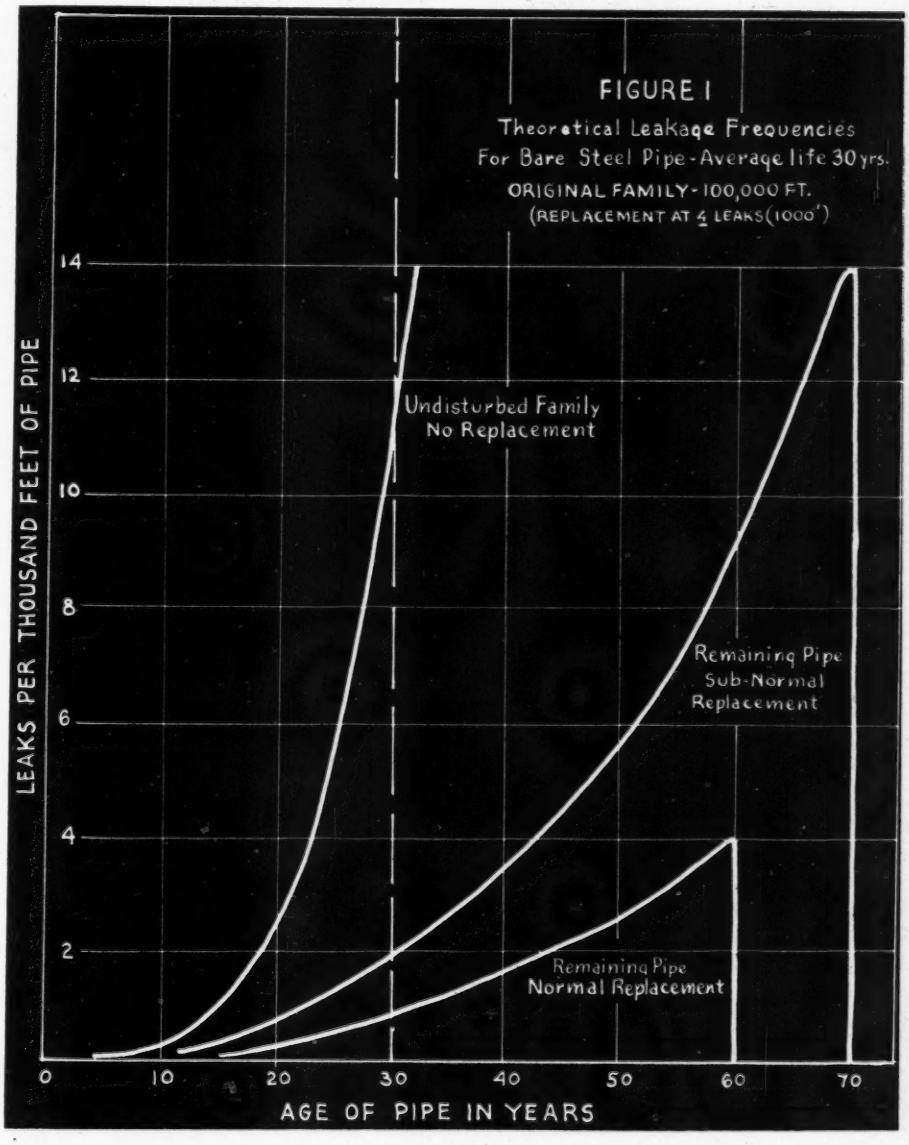
By **ELTING HENDERSON** • Southern California Gas Co.

DURING the past several years many excellent reports concerned with various aspects of distribution systems maintenance have been undertaken. The number and the quality of these reports indicate very clearly the importance of maintenance to the gas industry and reflect the interest displayed toward it by the men who are responsible for the safe and economical operation of gas distribution systems.

These reports present a definite challenge to anyone attempting to discuss this subject. So much information concerning maintenance activities has been presented that there is little to add with regard to specific techniques and procedures. Leak survey procedures, pipe coating standards, cathodic protection, leak repair techniques—all have been discussed in some detail. As a matter of fact, there is such a wealth of data available on specific aspects of distribution maintenance that it is sometimes difficult to keep the over-all objectives of distribution maintenance in mind. The trees obscure the forest, so to speak.

In view of this, it might be well to review this matter from a different perspective, concentrating on the broader, more basic aspects and considering individual techniques and procedures only briefly and in relation to the over-all picture.

In other words, an analysis of the subject of distribution systems made from the viewpoint of the management personnel who are responsible for the safe, sound and economical operation of the system, who must be aware of all the particular maintenance operations which can be used, but who at the same



time must maintain the proper balance between these operations.

This involves consideration of two questions: First, what basic objectives should be accomplished by a maintenance program? Second, what management activities are necessary to assure sound formulation and administration of the maintenance program.

The term maintenance is used not in the limited accounting sense of repairs, but in the broader sense of every activity intended to prolong the safe operating life of the distribution system. This includes not only leak repairs, but also reconditioning, cathodic protection, replacement and any other operation which will extend the life of a pipeline.

Basic objectives

What should a maintenance program accomplish? It seems to me that the following three basic objectives should be achieved:

1. Hazardous conditions should be eliminated.

2. Gas losses should be reduced to the point where further maintenance activities cost more than the value of the gas which would be saved by them.

3. The distribution system should be perpetuated.

The significance of the first two of these three objectives is rather obvious and probably doesn't warrant much discussion here. Elimination of hazards and reduction of product loss are clearly necessary goals of any distribution maintenance program, and are not likely to be overlooked even on a short-range basis. The concept that a maintenance program should have as a major objective the perpetuation of the distribution system is one that might not be quite so obvious, however, and one that unfortunately is often neglected in the press of day-by-day maintenance activities. Therefore, I want to discuss this objective in more detail.

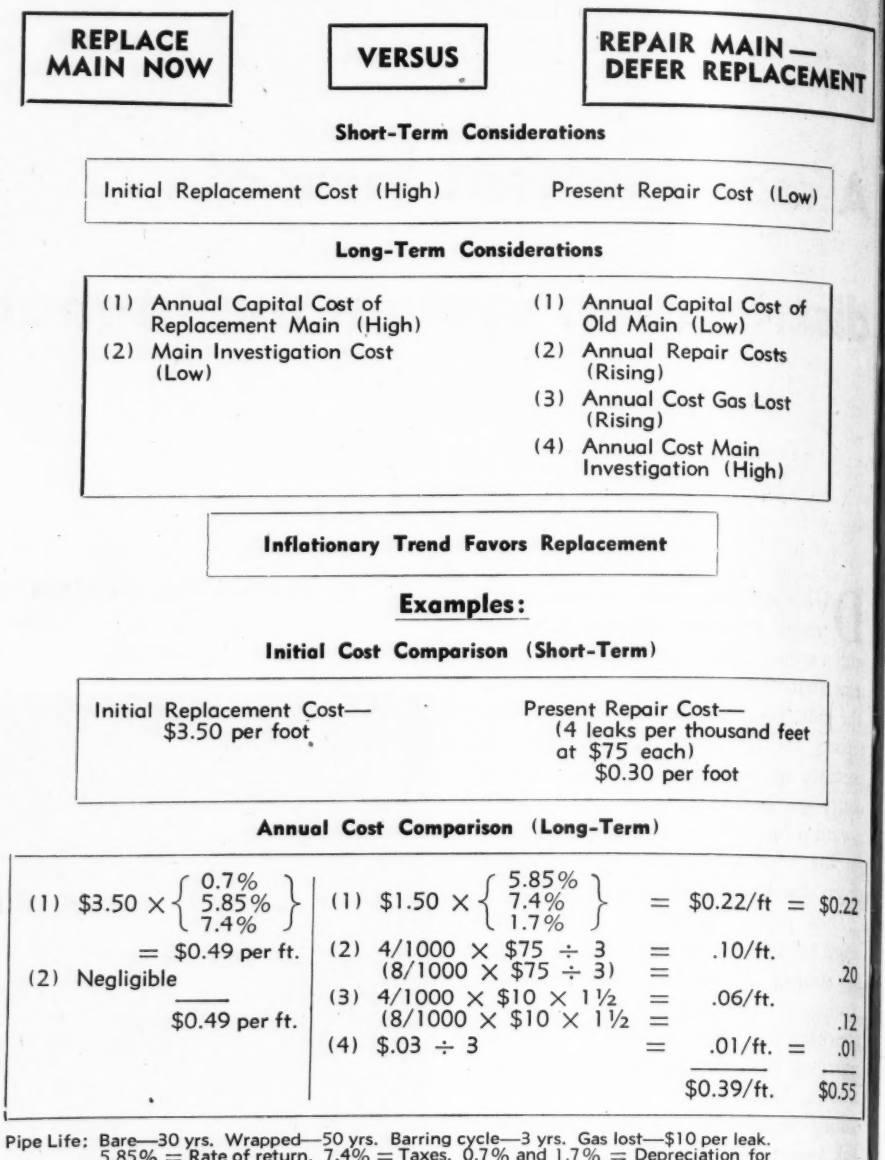
At first glance, perpetuation of the distribution system might seem to be a more or less incidental by-product of a maintenance program, rather than a basic objective deserving attention in its own right. Certainly if hazardous or potentially hazardous leaks are repaired and if gas losses are kept to an economic minimum, the distribution system will continue to be in a safe and sound operating condition. There are such serious pitfalls in this line of reasoning, however, that I would like to present for your consideration the concept that perpetuation of the system should be the underlying concern of the maintenance program, and that hazard control and gas-loss reduction activities should be carried on in a manner consistent with system perpetuation objectives, rather than vice versa.

This is not to imply that these are subordinate activities, or that they in any sense conflict with the goal of system perpetuation. Certainly the safety of the public it serves is of paramount importance to any gas utility. However, the decision as to which alternate maintenance operation to perform in correcting a hazardous condition—for example, the choice between repair or replacement—should be based whenever possible on the long-range considerations relating to perpetuation of the system rather than solely on the immediate problem of fixing a particular leak.

Three factors

This approach to distribution maintenance is based upon three closely related factors. First is the certainty of the distribution system's deterioration. Even with recent developments in corrosion control, absolute protection of pipeline facilities appears to be economically impossible. Although tremendous strides have been made in increasing pipeline life, there is still the problem of the sub-

FIGURE 2:
ECONOMICS OF "THE REPLACEMENT DECISION"


REPLACE MAIN NOW
VERSUS
REPAIR MAIN— DEFER REPLACEMENT
Short-Term Considerations
Initial Replacement Cost (High)
Present Repair Cost (Low)
Long-Term Considerations
(1) Annual Capital Cost of Replacement Main (High)
(2) Main Investigation Cost (Low)
(1) Annual Capital Cost of Old Main (Low)
(2) Annual Repair Costs (Rising)
(3) Annual Cost Gas Lost (Rising)
(4) Annual Cost Main Investigation (High)
Inflationary Trend Favors Replacement
Examples:
Initial Cost Comparison (Short-Term)
Initial Replacement Cost— $3.50 per foot
Present Repair Cost— (4 leaks per thousand feet at $75 each) $0.30 per foot
Annual Cost Comparison (Long-Term)
(1) $3.50 × { 0.7% 5.85% 7.4% } = $0.49 per ft.
(2) Negligible
$0.49 per ft.
(1) $1.50 × { 5.85% 7.4% 1.7% } = $0.22/ft = $0.22
(2) 4/1000 × $75 ÷ 3 = .10/ft.
(8/1000 × $75 ÷ 3) = .20
(3) 4/1000 × $10 × 1½ = .06/ft.
(8/1000 × $10 × 1½ = .12
(4) $.03 ÷ 3 = .01/ft. = .01
$0.39/ft. $0.55

Pipe Life: Bare—30 yrs. Wrapped—50 yrs. Barring cycle—3 yrs. Gas lost—$10 per leak. 5.85% = Rate of return. 7.4% = Taxes. 0.7% and 1.7% = Depreciation for 50 and 30 yrs.

stantial portion of the system which has been installed prior to the development of such corrosion control techniques. Consequently, distribution management must realize that at some time in the future, the necessity of major maintenance activities of one sort or another must be faced. (As a reminder, the word maintenance is again used in the broadest sense of the word.)

The second factor basic to this approach to distribution maintenance is a consideration of the rate at which such deterioration takes place. The studies which have been made on the rate of corrosion leakage indicate that once corrosion leakage begins, it continues at a progressively increasing rate. If the cumulative leaks per unit length for a given section of unmaintained line are plotted against time, the resulting time-total leak curve rises in an exponential progression *(Fig. 1)*, at least past the limit of practical operating condition. The interval before any corrosion leakage starts in a new system and the subsequent rate of increase will vary of course with pipe wall thickness, soil type *(Fig. 3)* and other factors, but once started, leakage continues to increase in this fashion. Unless the nature of this time-leakage relationship is recognized, distribution management may be lulled into a false sense of security. The fact that leakage rates are low during a given period of time is no assurance that they will continue to be so. On the contrary, they can normally be expected to accelerate at an ever increasing rate as pipe life increases. As a result, the need for maintenance becomes increasingly pressing, and repair activities alone become increasingly costly and progressively less effective.

If new installations were made at an even, constant rate throughout the years, this might present no major problem since the result would be a reasonably well-balanced maintenance load. However, as you know, new installations of distribution facilities are made to meet customer requirements, not to level maintenance requirements. A major building boom results in increased construction activity over a relatively short period of time and then tapers off; or a new territory is supplied with gas for the first time and an entire distribution system installed, again over a relatively short period of time. As a result of this situation, plus the typical exponential progression rate of corrosion, distribution management is faced with a complex maintenance scheduling and control problem that cannot be handled satisfactorily on a short-range, "fire fighting" basis.

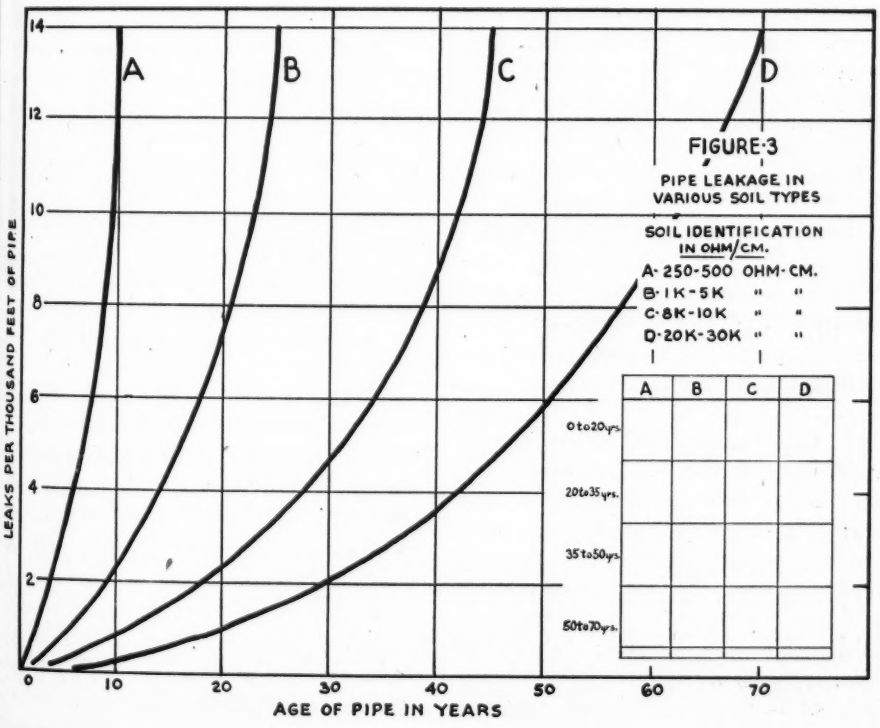


FIGURE 3
PIPE LEAKAGE IN VARIOUS SOIL TYPES

Elting Henderson will retire on Oct. 1 as manager of distribution for Southern California Gas Co. after a total of 45 years in the gas industry.

In this article he calls upon his extensive background in the field to bring together the operational and managerial points of view for a practical approach to the oft nebulous and generally controversial subject of distribution system maintenance. His thoughts are based upon broad personal experience in grappling with the problem of when and how to maintain a gas line distribution network in a way that will satisfy good operating practice and at the same time fall within the bounds of sound financial policy—a task that has made him familiar with the ground where angels fear to tread.

Mr. Henderson took his first job in the industry in the fall of 1907 with the Kansas Natural Gas Co., after becoming disappointed with opportunities for advancement offered by the railroad industry. At the time he was employed in a compressor station at Scipio, Kan., and paid the exorbitant sum of $25 a month.

On the first of October 1914, he came to work for the Southern California Gas Co. at their Taft, Calif., compressor station. He recalls pumping maximum daily loads of as much as 13 MMcf, and draws a comparison with present day hourly loads far in excess of this figure.

After retirement, Mr. Henderson first plans to visit with old friends in Kansas and catch up on some overdue hunting and fishing. Then, in true warhorse fashion, he plans to undertake a substantial load of consulting activity in the gas industry.

Financial implications

The third closely related factor is based on a consideration of the financial implications inherent in both of the first two factors. In a typical gas distribution utility, the dollar investment in the mains and services of the distribution system constitutes the biggest single capital outlay—generally a very substantial proportion of the company's total investment in all facilities. Likewise the expenditures for distribution operating and maintenance activities represent

a major portion of the total annual cash requirements.

Consequently, distribution management personnel have a major financial responsibility which goes beyond merely assuring that current expenditures are sound and that day-to-day activities are carried on as economically as possible. It is essential that all necessary operations, both short-range and long-range in nature, are provided for in financial planning and that major future financial requirements are made known to the officers of the company who are responsible for rate matters and fund raising.

Unless a comprehensive maintenance program is established, with system perpetuation a basic objective, the company may be faced with major cash requirements for urgent maintenance work when it is least prepared to meet them. This is particularly a problem in a period of inflation such as we have experienced during the past several years when normal depreciation allowances represent only a small portion of the cost of replacing old facilities at current prices. Failure to recognize the inevitable nature of maintenance requirements results in an understatement of the total current costs of operating the system and providing for its permanent serviceable condition.

Planning needs

Consideration of these factors emphasizes the need for management planning of the highest order to assure sound formulation and administration of the distribution maintenance program. It also highlights the need for a comprehensive and long-range maintenance program, rather than one which is based on the obvious requirements of the moment.

Several advantages result from such long-term planning. It maps out major financial requirements well in advance of actual need. It permits forecasting of personnel requirements. It rationalizes the purchase of materials, equipment and supplies. It enables long-range consideration to be made of the relative merits of contractor vs. company operations for the particular program contemplated. In short, it changes maintenance work from a "fire fighting" activity to one typifying the best in management planning and control.

Management activities

What work must be performed in order to assure that a maintenance program accomplishes these objectives? Discussed below are several activities for which management should provide in the development and operation of a maintenance program. These are presented in the general order in which they might be undertaken in the initial development of such a program.

It should be emphasized, however, that a successful maintenance program is not a static thing — it must be changed as often as necessary to take advantage of any technical developments and to reflect changing economic conditions. Consequently these activities should be continued even after the initial program has been instituted. The degree of attention each receives will vary, of course, depending on the particular situation faced and the state of development of the program. These activities are closely interrelated, however, and management should be alert to see that developments in one activity are translated into appropriate changes in the others.

1. Determine the status of the existing system. Before undertaking any comprehensive maintenance program, the nature and extent of the maintenance problem must be ascertained. This requires an assessment of the amount of pipe in the system, summarized in terms of probable maintenance requirements: i. e., so many feet of pipe in poor condition requiring immediate attention, so many feet in generally good condition at the moment, and so many feet which can be expected to require little attention for some period of time.

This admittedly requires a good deal of judgment and at least initially may have to be based on some rather general assumptions as to pipe life expectancy. Unfortunately from a maintenance viewpoint, few distribution systems are installed all at one time and under identical corrosion conditions—typically they consist of pipe of a wide range of ages, protected against corrosion in a number of ways, and installed in a variety of corrosion conditions. Past experience with maintenance needs must be evaluated in terms of these variables, which is frequently difficult simply because necessary information is not available.

It is important to relate maintenance requirements as closely to these variables of pipe protection and corrosion conditions as available data will permit, however. There is real danger in predicating a maintenance program upon a system average pipe life figure. Such an average may be anything but typical of the actual life expectancy of pipe installed under certain conditions. A program based on an historical 30 years "average" pipe life, for example, will obviously not be suitable for an area in which unprotected pipe can be expected to last for only 10 years. Consequently, management must identify as precisely as possible the factors which affect pipe life and modify current records as necessary to make this information available for subsequent studies.

A tabulation of the number of feet of pipeline of various ages based upon the graphical representation of the life expectancy of the pipe for the type of soil in which it is located *(Fig. 3)* will provide a starting point for a comprehensive maintenance program. Such a pipeline inventory indicates the extent and timing of the proposed maintenance. Continual revision of both soil type curves and tabulation chart are made on the basis of inspection procedures.

2. Develop a long-range maintenance schedule. The first activity results in an assessment of the probable maintenance work load over a period of years. The next step is the development of a long-range maintenance schedule, which will spread this work out over a reasonable period of time. It may be desirable or necessary from an operating point of view to level the work, falling behind the optimum schedule at times,

> It should be pointed out that the data with respect to time-leak relationships presented in this article are for unprotected steel pipeline. While the basic techniques for determining corrosion development may be applied in all instances as a means for arriving at a safe and economically sound program of distribution system maintenance, certain additional factors must be taken into consideration in dealing with other than steel pipeline that is wrapped or otherwise protected against corrosion. Physical damage to the pipeline wrapping, failure of the cathodic protection system as well as the long term effectiveness of the system, and the type and effectiveness of the corrosion protection wrapping are among the factors that may distort data having to do with the number of leaks predicted for a given section of line over a period of years. Because of the relative newness of the various methods of corrosion protection very little actual data are available on this subject.—*The Editor.*

getting ahead at others, in order to have a reasonably constant volume of work each year. Or it may be necessary to work out a schedule which is a compromise between what is technically desirable and what is financially possible, at least initially.

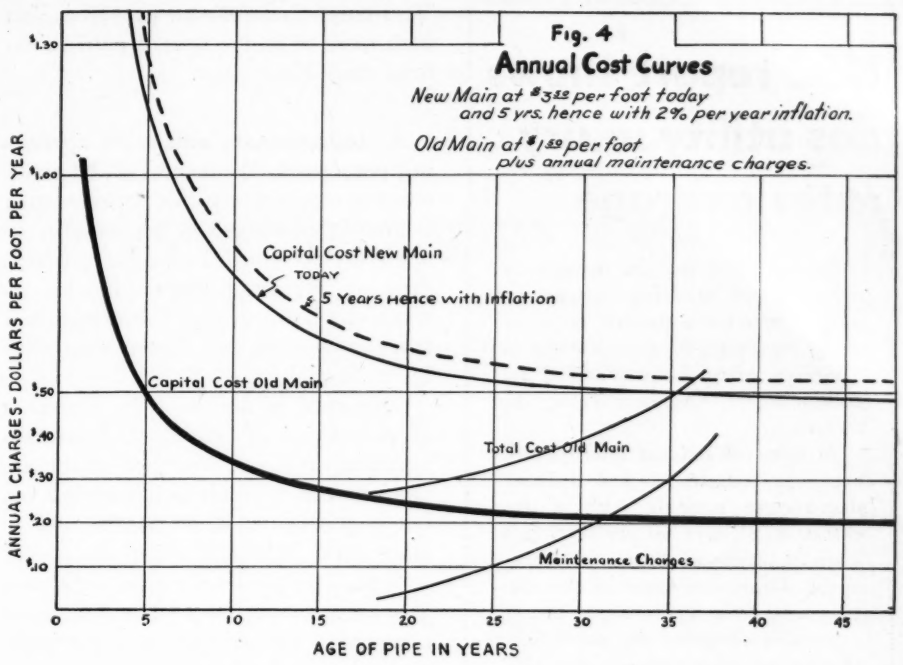
It is obvious, however, that financial restrictions cannot prevent essential maintenance work from being performed for any length of time, if the company expects to stay in business. The cost of maintaining the system, of prolonging its life to meet future service requirements is one of the essential costs of gas service and must be reflected in current rates. The distribution executive should, of course, take advantage of every development in corrosion control and maintenance techniques, to progressively reduce this cost. He cannot in good conscience, however, allow essential maintenance requirements to be neglected because of short-sighted financial policies. To do so, is simply to substantially understate present costs at the expense of consumers in the future.

As mentioned earlier, such a schedule provides a basis for planning personnel requirements, for anticipating financial requirements, for forecasting material and equipment needs, etc. It can be of invaluable aid to the management of a distribution department in formulating basic departmental plans and objectives.

3. Develop economic bases to determine which of the alternative maintenance procedures is to be used under particular circumstances. An integral part of developing the maintenance program must be the establishment of bench marks or guides to use in determining which maintenance alternative is to be used under various circumstances. Repair, replacement, cathodic protection, reconditioning — each may be most suitable under particular conditions. The danger to be avoided is the practice of using one remedy for all ills, regardless of its appropriateness.

The test of appropriateness is cost. Not immediate costs, for these can be misleading, but cost per year of remaining life. This figure not only indicates the cost of the maintenance activity itself but also its effect on the life expectancy of the facility. This concept is demonstrated in the economic analysis made in *Fig. 2,* which is a comparison of the relative cost of repairing leaks vs. replacing the same section of line. A graphical analysis of the relationship between the two alternatives is given in *Fig. 4.*

Fig. 4



This example is presented only as an indication of the type of cost comparison which should be made, not as the precise formulae to be used in all cases. The values used will vary under different conditions; additional cost factors can be included and refinements can be introduced in the calculation of depreciation and of capital costs. It does demonstrate, however, the importance of recognizing the effect of each maintenance alternative on pipe life. In the sample calculation, the immediate cost of repair seems to be much less than that of complete replacement. When related to life expectancy after the maintenance work is completed, however, the annual cost of replacement is significantly lower.

Management should provide its operating personnel with these or similar economic guides to use in choosing between the various alternate maintenance operations which might be used in particular situations. They should be presented and used as guides only, however, not as inflexible rules. The mathematical preciseness of these formulae tend to mask the considerable judgment and consequent chance for error involved in assigning values to certain factors, remaining pipe life in particular. These formulae are available as guides for common sense, not as substitutes for it.

4. Develop procedures to identify the specific portions of the system which are to receive maintenance attention. The activities described so far provide only general guides for the administration of the maintenance program. They lead to the establishment of annual amounts of maintenance work, work designed to extend the life of the system at the lowest possible annual net cost. They do not, however, identify the specific sections of the system for which appropriate maintenance activities should be considered.

This is a matter of surveying the system, starting with the particularly suspect portions, to identify the specific sections which are to receive maintenance attention. There are a number of survey techniques available, each particularly suitable under certain circumstances.

Again, the rule of cost should apply in selecting a survey procedure. If a definite amount of maintenance work has been budgeted, the survey procedure should identify the sections which most urgently require attention—"the worst first"—but should only be as extensive and refined as necessary to accomplish this. If maintenance work far in excess of current budget allocations has been backlogged, then no elaborate survey procedure is warranted.

In considering survey techniques, this point should not be overlooked: Normal surveys are related to the routine maintenance program in which economics is a major consideration. Under certain circumstances economic considerations are secondary, e. g., the distribution system adjacent to a school or hospital or in a densely populated business district. Under such circumstances, special "insurance" surveys may be conducted without regard to tangible economics and

NSC report shows gas utility injury rates average

During 1952 the gas industry recorded 14.40 disabling injuries per million man-hours against an all-industry figure of 8.40 as reported in the National Safety Council annual statistical report, "Accident Facts," for the year.

In terms of accident severity, however, the industry showed a better-than-average standing with a time charge of .81 days lost per 1000 man-hours as against an all industry average of .88. Figures are based on all industries submitting reports to the council.

In both categories the gas industry showed an improvement over 1951, with the greatest change in accident severity where the report showed a decrease of 22%. Injury frequency rate decreased 8% over 1951.

Injury rates for all industries reporting during the past year show a substantial reduction in both frequency and severity as compared with 1951. Thirty-one of the 40 basic industry classifications reduced their frequency rates, and 25 reduced severity rates. The average accident frequency rate was reduced by 7% and the average severity rate by 9%.

The communications industry led all others by turning in the lowest employee frequency rate. It reported 1.61 disabling injuries per million man-hours for a reduction of 10% over 1951. Communications also had the lowest severity rate with .10 days lost per 1000 man-hours, an 11% increase over 1951.

The electrical equipment industry ranked second in accident frequency with 3.38, followed by the automobile industry with 3.62. Cement, third in 1951, dropped to sixth.

Lumbering stayed at the bottom of the frequency list in 1952 with a 35.48 rate, although this figure represented an 18% reduction. Underground coal mining remained next to last with a 33.00 rate, and mining, except underground coal, was third from the bottom.

Wholesale and retail trade was second in the severity category with .14 and tobacco ranked third with .23. Both aircraft manufacturing and the automobile industries had sizeable reductions in their severity rates of 46%, moving up to sixth and seventh places respectively.

"insurance" maintenance provided, also with more of an eye toward public relations than direct costs.

5. Indoctrinate and train operating personnel. The success of the maintenance program depends entirely upon the understanding and cooperation of operating personnel. In the final analysis, they are the group responsible for its effective administration. Consequently it is essential that they know what they are to do and why.

This must go beyond a flat statement of policy and of procedure. The management activities described above are not intended to result in inflexible rules, but in procedures which can be used to assist good judgment. Such procedures, to repeat, are guides for good judgment; they are not substitutes for it. A decision concerning maintenance in a particular situation is in essence only a best guess. Therefore it is important that all the people involved in that decision—the field survey crew, the clerk posting leakage reports, the engineering supervisor initiating a maintenance order, the field crew responsible for the actual work—are aware of the basic objectives and approach of the program.

This requires some sort of a planned training program. The cost of the maintenance program is too great, it is too important to the company's success, for distribution management simply to assume that operating personnel have learned enough about its objectives and operations through experience. Management must "package" experience in the form of training to make sure that every person concerned with the program is qualified to perform his part and is aware of its relationship to the work done by the other people concerned.

6. Periodically re-evaluate status of program. There is a tendency for a program of such magnitude once started to roll ponderously on, without regard for current conditions. Nothing can be more dangerous for the continuing success of the maintenance program. Its initial development must be in terms of the best job at the lowest cost and its subsequent application must be guided by the same standard. Changing operating techniques, innovations in corrosion control, changing financial conditions—all must be reflected in the day-by-day administration of the program.

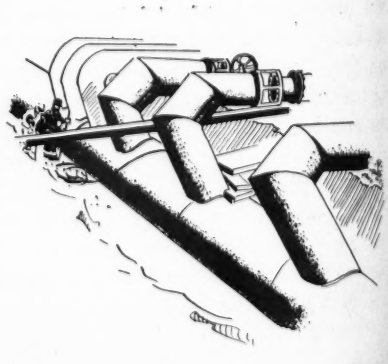
The distribution executive should therefore periodically appraise the entire maintenance program in light of current conditions. Are the basic economic rules of thumb still valid? Does the survey procedure being used best meet the needs of the program's present status? Are field survey and maintenance techniques as effective as possible?

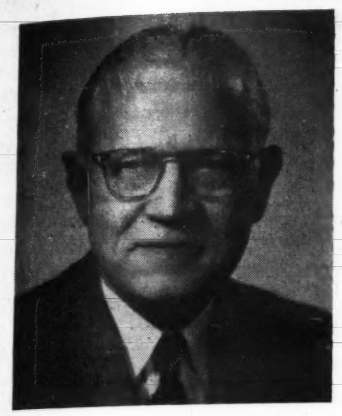
Such a review also affords an opportunity to check on the administration of the program. It may be that the program itself is basically sound, but as a result of misinterpretation or misapplication of policies, its administration is not accomplishing desired results. A maintenance program of this type is fairly complex and minor errors or misunderstandings in the administration of one part of it can pyramid into significant errors in final results. A periodic review can help to prevent this.

A maintenance program can never be a static thing, for if it is basically sound, it should result in a progressive upgrading of the facilities maintained. Consequently, change should be expected in all aspects of the program.

To repeat, the activities presented above are interrelated to a high degree and developments in one field must be reflected in all the others. For example, periodic re-evaluation of the program's operation may indicate the need for a more refined survey of the system itself or for a redefinition of pipe coating standards or soil corrosivity classifications. The goal should be refinement and improvement in each of these activities, to the point where further refinements no longer significantly improve the maintenance program itself.

Although these activities, when presented so generally, as here, may appear so obvious as to be trite, their very obviousness may cause them to be overlooked in the pressure of day-to-day operation of the distribution system. They represent an approach, however, which is essential to the formulation and administration of a maintenance program which enables the distribution executive to discharge his responsibilities to the company, its employees and its customers.





"Superb" is the rating the American Institute of Management gives C. H. Gueffroy, president of Portland Gas & Coke, who combines the functions of board chairman and general manager de facto.

Portland Gas wins award for management excellence

Production development, under the direction of Vice President James F. Bell, won the plaudits of the institute. AIM was impressed by the manner in which gas manufacturing processes have been improved to meet strong competitive threats.

"The company's sales vigor, especially for gas, is exceptional for a manufactured gas company," says AIM. Evidence of this are the "efforts to secure new, permanent outlets for the company's gas" and the dealer sales assistance program. R. G. Barnett heads up the operation as vice president for sales.

MANAGERIAL skill of a high order has earned for the Portland (Ore.) Gas & Coke Co. a Certificate of Management Excellence, according to an audit report issued last month by the American Institute of Management to its 10,000 members.

"Facing difficulties such as are seldom encountered in the utilities industry, Portland Gas & Coke Co. not only has succeeded in preserving its identity as an independent enterprise but, in recent years, has increased its earning power and established those earnings on a far firmer foundation than in the past," the report states.

"Almost unique in its industry, the company has had to contend with the multiple problem of intense and growing competition, an unfavorable price trend for its basic fuels, a loss of domestic consumers as residential vacancies have succeeded the housing shortage of the war years, and a relatively slow pace of growth of industrial customers. No other utility company in the nation has had to contend simultaneously with all these difficulties. No other, indeed, has been at so pronounced a disadvantage in terms of competition."

The AIM award commended the company for overcoming such obstacles as the heavy competition from nearby hydro-electric power projects financed by federal funds, the growth in use of heating oil for space heating, and the lack of natural gas.

In terms of research, both basic and applied, the report declares, Portland Gas & Coke is "the outstanding company in its industry."

"Continuing research," it adds, "has led to the development of equipment, processes, and operating techniques which have enabled the company to use a fuel that is heavier and costs less than that used by any other producer of oil gas. In addition, the firm has pioneered the development of equipment and operating techniques for the efficient recovery of oil gas residuals, and the processing of these residuals into marketable products, including aromatic light oils, wood preserving oils, naphthalene,

HOW PORTLAND GAS RATES

Category	Optimum Rating	Minimum Rating for Excellence	Analysis Rating
Economic Function	400	300	400
Corporate Structure	500	375	425
Health of Earnings Growth	600	450	500
Fairness to Stockholders	700	525	500
Research and Development	700	525	700
Directorate Analysis	900	675	700
Fiscal Policies	1100	825	900
Production Efficiency	1300	975	1150
Sales Vigor	1400	1050	1000
Executive Evaluation	2400	1800	1900
Total Points	10,000	7500	8175

● GROWTH RATE GOOD, SAYS AIM

"The rate of growth of system capacity has been unusually good for a company operating in a difficult area. It has not, however, been accompanied by a corresponding growth in load factor, partly because of the rise of residential vacancies as certain of the population has left the area in recent months, and partly because the plant has been expanded to meet an anticipated future growth in population and gas consumption."

Meter change callback plan wins $600 prize

THE development of a telephone call-back procedure to improve the efficiency of making gas meter changes has earned John H. Willebrands of Pacific Gas and Electric Co., San Francisco, a $600 check from his company for the best employee suggestion made in the last year. It was the top award out of nearly 2000 money-earning suggestions.

Mr. Willebrands, chief gas service operator for PG&E's East Bay Division, supervises the changing of about 25,000 old-age meters annually. He ran into the double-edged problem of many wasted man hours on "no-answer" calls to homes, and of unsatisfactory public relations created by turning off service to make changes when nobody was home.

As a result, he organized the telephone call-back system, which is used after one visit to a residence to give the usual 15-day notice of the meter change.

Under the old procedure, about 4000 homes a year were cut off because of inability to contact the customers and arrange a time for the meter-change when the customers would be at home. Last year, Mr. Willebrands reported, only 20 customers were cut off.

The telephone call-back procedure uses the "reverse" telephone directory which lists telephone numbers by street addresses—formally called the "street address telephone directory."

About a week after the 15-day notice has been left at an address when nobody is home, a service operator in the PG&E office in Oakland starts telephoning to arrange a time for the meter change to be made. The "hard-to-get" numbers are tried as early as 7:30 a.m. or as late as 8 p.m.

The customer contacts made by telephone serve the double purpose of improving public relations and of keeping the meter-changing crews well scheduled, Mr. Willebrands explains. The result has been proved by marked drops in no-answer calls to homes, in the time which customers are without gas, and in the reduction of overtime work. Saturday changes generally are scheduled for a day when there are enough to keep a serviceman busy for a full working period.

electrode binder pitches, and lampblack briquettes.

"The company also discovered a method of using sulfonates for the demulsification of gas residual tars. And its utilization laboratory pioneered in the construction of central heating equipment before such appliances were commercially available."

Development of oil gas residual products capable of being marketed in competition with coal tar chemicals resulted in gross by-product sales by the company in 1952 amounting to $4,660,000. Other significant developments singled out in the report include:

Conversion of gas generators to automatic controls in such a way as to eliminate entirely the use of diesel oil, thus saving the company over $2.5 million annually in operating expenses at current oil prices.

Development of new production techniques which, being installed this year, are estimated to cost no more than $450,000 but will result in savings of $370,000 annually.

The first commercial application of the removal of aromatic light oils from manufactured gas streams, resulting in the marketing of Gasco motor fuel, a motor benzol blend sold in competition with gasoline.

The undertaking of an expensive plant program to explore the possibility of producing a high Btu gas from the heaviest types of fuel in such a manner as to yield, as by-product, a tar suitable for processing into binder pitch for the aluminum industry.

In addition to its vigorous research and development, the institute observed, the company has excellent labor relations. There has never been a stoppage in the history of Portland Gas & Coke, the report points out.

"Formal grievance procedures have been established and are integrated in worker-management agreements and contracts. A funded pension plan operates desirably, plus liberal sick pay, group insurance, paid vacations and holidays, and similar direct and indirect benefits.

"The conditions of work are superior to those generally prevailing in this area —a fact of which the employees are fully conscious and appreciative. The rate of labor turnover is therefore insignificant."

To date, the unavailability of natural gas has placed Portland Gas & Coke Co. at a cost disadvantage. "However, within the next few years," the report predicts, "it appears quite certain that natural gas in ample quantity will be made available to the company, insuring a lower cost operation and thus broadening the market for the company's main product. This will, of course, involve considerable new investment, estimated to approximate $18 million over a five-year period after natural gas has become available. Of this amount 85% represents mains, service meters, and regulators required to serve new customers, the balance being the cost of conversion of existing facilities plus the possible abandonment of certain by-product operations which would then be uneconomic as compared with new by-product opportunities.

"It is particularly interesting to observe that total 1952 costs, including taxes and interest, were not appreciably higher than those of 1946, considered as a percentage of operating revenues. This is especially commendable since direct taxes absorbed only 6.6% of the operating revenue in 1946, compared with 13.0% in 1952. In other words, excluding taxes and interest charges, the operating ratio of 77.6% experienced in 1946 was reduced to 74% in 1952 despite the limiting effects of wage increases and fringe benefits to employees and the over-all effects of the inflation from which the company suffered.

"Earnings are now firmly based, deriving not only directly from the profits earned on sales, but also from the successful and imaginative endeavor of this management to overcome natural and locational disadvantages of unusual intensity."

● BOARD HAS GOOD ATTRIBUTES

"All the 11 directors of Portland Gas & Coke Co. are resident within the company's service area. This, the institute believes, is a gratifying fact, making for close local supervision of the operation by the directors and for continuing familiarity of all board members with the problems facing the company and the means being adopted for their solution.

"The board is unusually representative. It embraces consumers, management, civic minded persons, and the banking profession."

● "GOOD . . . EXCELLENT . . . SUPERB"

"In brief, the institute believes the management personnel of the Portland Gas & Coke Co. to be excellent on the lower and middle levels, superb in the office of chief executive, good in most parts of the second rank of the leading executive officers."

An improved design for high capacity line burners

By W. M. DOW and BURNIE PORTER • United Gas Corp., Shreveport

A search for a pipe or line burner that will have a high capacity yet will retain acceptable burning and heating characteristics has culminated in the designing of a new burner with a capacity six to 10 times that of conventional extended-flame burners. It may be used effectively as a single, high-capacity line burner or may be fabricated into gas grates with capacities up to 600,000 Btu/hr/sq ft of grate area.

Commercially available line burners have a common design feature: the total port area does not exceed the cross sectional area of the burner manifold. The maximum capacity is about 1500 Btu/hr/linear inch of flame length for blue flame operation. Standard design criteria specify that line burners should not be designed for lengths greatly exceeding 6 ft and that the cross-sectional area of the manifold should not be less than the total port area. These design conditions of length and area ratio impose serious limitations on the capacity and utility of this type of burner. Various forms of cast iron line burners, fabricated into gas grates, are widely used for heating boilers. In general, these burners have a constant width but a sloping plane surface as a bottom, so that the height of the burner manifold at the dead end is about one-fifth of that at the inlet end. The total port area is never greater than the cross-sectional area of the burner manifold at the inlet end.

This article, adapted from a paper presented at the eighth annual short course in gas technology, held at the Texas College of Arts & Industries, Kingsville, is an extension of an article published in the September 1950 issue of *GAS*, (page 35 et seq). While that article stated, in general, what could be done in the way of new design, this report rounds out the study and shows what has been accomplished.

Development of improved line burner design

If a conventional line burner were constructed with the total port area greatly exceeding the cross-sectional area of the inlet end of the burner manifold, it would produce a very unsatisfactory flame distribution along its length. In general, the flame height would be very high at the dead end of the burner and either non-existent or very low at the inlet end. If the total port area were reduced to less than the cross-sectional area of the burner manifold, the flame distribution would be uniform.* However, this greatly reduces the burner's capacity, which is directly proportional to the total port area. It is impractical to construct a line burner with a high capacity and a length exceeding a few feet in accordance with the conventional rules of thumb, because it would have such a large manifold diameter. A larger burner diameter is undesirable not only because it makes a large, bulky, and expensive burner, but because it also results in many undesirable burner operating characteristics, such as sluggish and loping flames, flashback, and loud extinction noises, all caused by the large burner manifold volume and the resultant low gas velocities.

The fundamental aspects of gas flow through a line burner manifold were investigated in order to design and construct a simple line burner which would have a total port area greatly exceeding the manifold cross-sectional area, and thus have a high capacity, but which also would have a uniform flame distribution along its length. This study showed that it is possible to construct such a high capacity line burner if the manifold flow area is varied along the burner length in a prescribed fashion.

The two primary factors which affect the distribution of gas flow from the burner manifold are the inertial forces and the frictional forces of the gas flow in the distributing manifold. As the gas-primary air mixture flows along the burner manifold its velocity decreases because part of the mixture is being bled off through each port opening and therefore the remaining part moves more slowly. This deceleration of gas flow tends to increase the static gas pressure; and this effect of the inertial forces of the gas flow, if not counteracted, would result in an increase in the rate of discharge and flame height toward the dead end of the burner. The second factor, however, acts in the opposite direction: the friction of the gas flow on the burner wall tends to decrease the static pressure toward the dead end.

Briefly, the theoretical treatment consisted of the mathematical development of the necessary conditions to insure that the pressure drop due to friction losses in the flow through the burner manifold is exactly balanced by the pressure increase due to the deceleration of the flow in the manifold. When these two pressure trends are exactly balanced, the static pressure remains constant along the entire length of the burner which insures a uniform flame height and uniform heat distribution.

In general, the pressure loss due to friction is related to the surface area of the flow path, while the pressure gain due to deceleration is related to the cross-sectional area of the flow path. Therefore, it is possible to control the static

*The area ratio is the most important factor in controlling the flame distribution, but it is not the only factor. The complete set of conditions which must be satisfied is given under case 4.

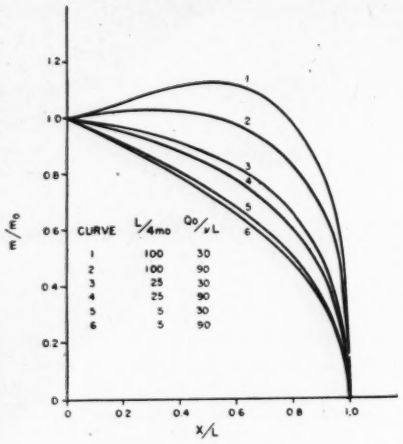


Fig. 1. Variation of hydraulic radius with distance along manifold for turbulent flow.

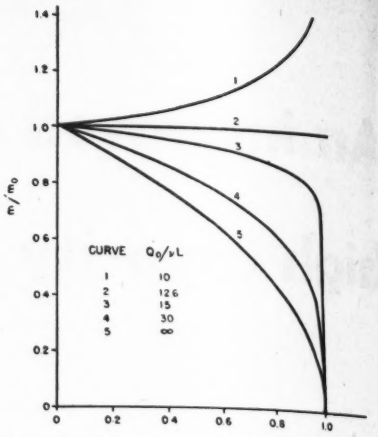


Fig. 2. Variation of hydraulic radius with distance along manifold for laminar flow.

pressure over the entire length of the burner by adjusting the ratio of these two areas. This can be accomplished by several means, such as inserting a tapered plug in the burner manifold or actually constructing the distributing manifold with a variable area.

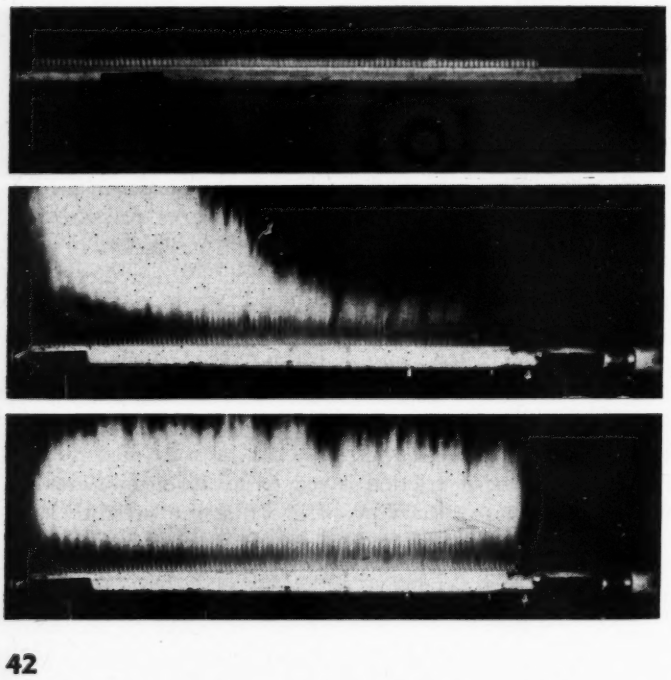
The theoretical analysis showed that it was possible to control the distribution of heat from a line burner by the simple expedient of varying the free cross-sectional area of the manifold with the distance along the burner. This variation must be made in a definite and prescribed manner dependent upon the physical dimensions and operating capacity of the burner. Thus, the total port area can be made much greater than the cross-sectional area of the manifold which results in a high capacity line burner.

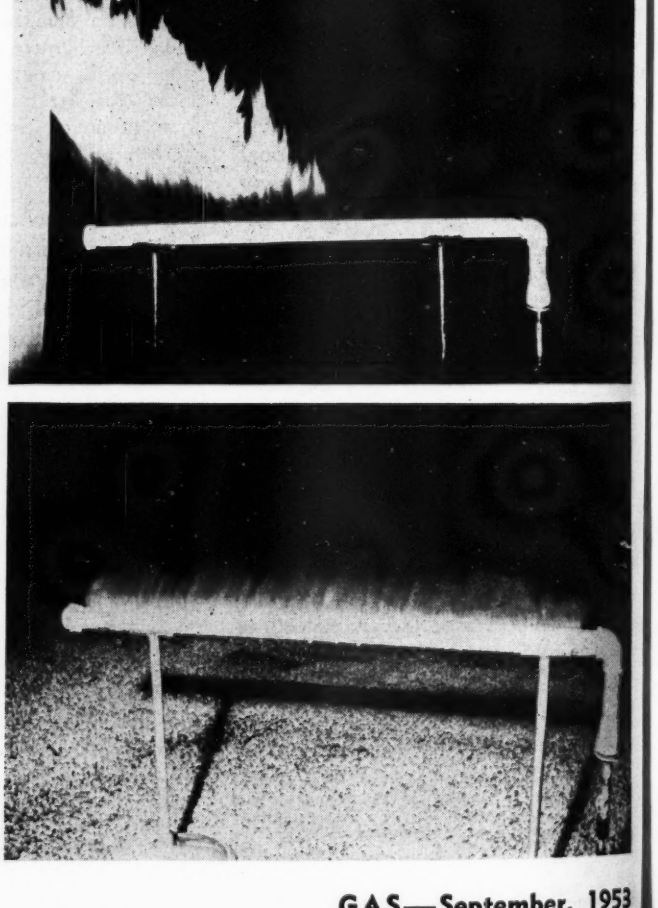
The influence of friction on the static pressure is a function of the flow conditions in the burner manifold. In general, the gas flow at the inlet of the burner will be in the turbulent region, Reynolds number $\frac{4mu}{\nu}$ greater than about 2100; but as the gas is discharged along the length of the burner the Reynolds number will decrease and laminar flow conditions will be established at some distance from the dead end. The Reynolds number changes from a maximum at the inlet end to zero at the dead end. The change in Reynolds number with distance is great; and consequently the transition from turbulent flow to laminar flow is rapid. For certain small, low capacity line burners the gas flow in the burner manifold may be in the laminar region along the entire length of the burner.

If the ratio of the burner length to diameter is small, less than about five and the gas flow is relatively high, then the influence of the inertial forces on the static pressure is much greater than the influence of the frictional forces. In this case the variation of the cross-sectional area simplifies to a linear taper of the area from a maximum at the inlet end to zero at the dead end. The variation of area is not linear, however, for a high capacity line burner which has a length to diameter ratio appreciably greater than five. Actually, the variation in area may be an increase or a decrease with length along the burner or, in some cases, an increase then a decrease, depending

Figs. 3a, 3b, and 3c (below): 3a is a conventional pipe burner (manifold serves as infinite reservoir). 3b is the conventional burner with total port area increased from 0.72 to 4.32 times the manifold area. 3c is the burner with increased port area but with tapered insert in burner manifold. Flow is from right to left.

Fig. 4a (top right) is pipe burner with large port area producing a very unsatisfactory flame. **4b (below)** is the same pipe burner with tapered insert to give uniform flame distribution.





upon the physical dimensions and rate of gas flow in the burner.

If the pressure changes accompanying the flow of gas through the manifold are negligible in comparison to the pressure drop across the discharge ports, then the flow will be distributed uniformly through the ports. In effect, this is the case where the manifold is so large that it is equivalent to an infinite reservoir. The dimensions and operating characteristics of commercial line burners satisfy the criteria for this classification. Consequently, even though they operate with a very uniform distribution of heat, they have a low heating capacity.

TABLE 1. PHYSICAL DIMENSIONS AND OPERATING CONDITIONS OF BURNERS FIG. 3 - 9.

Burner	Flame Length, ft	Cross-section Area of Manifold, sq in.	Total Port Area, sq in.	Total Gas Flow, cu ft/hr.
Fig. 3 (a)	4	3.36	2.42	50
Fig. 3 (b)	4	3.36	14.52	580
Fig. 3 (c)	4	3.36	14.52	580
Fig. 4 (a)	5	4.79	30.0	600
Fig. 4 (b)	5	4.79	30.0	600
Fig. 5	5	4.79	30.0	-
Fig. 6 (a)	3	0.304	0.903	5.0
Fig. 6 (b)	3	0.304	0.903	7.8
Fig. 6 (c)	3	0.304	0.903	3.5
Fig. 7	5	4.50	32.0	1,500 Max.
Fig. 8	2	1.56	4.0	100
Fig. 9	2	1.10	2.4	60

Mathematical development of design conditions

The necessary conditions for satisfactory performance of line burners were disclosed by a mathematical consideration of the more general problem of the uniform distribution of a fluid flowing through a perforated pipe with a closed end. The mathematical details of this development have been presented in a previous article.* Only a brief summary of this mathematical development will be given here.

For mathematical purposes the discharge of the gas through the ports may be considered as a continuous function of the distance along the manifold. An energy balance for a differential length dx of the burner is

$$\frac{u\,du}{a} + \frac{dp}{\rho} + \frac{2fu^2\,dx}{4m} = 0 \quad (1)$$

The first term in *Equation (1)* represents the inertial forces, while the third term represents the frictional forces. If these two terms are exactly balanced then the second term will be equal to zero, and consequently the static gas pressure will remain constant along the length of the burner. This fundamental energy-balance equation may be solved for the various flow conditions to give the necessary variation of the manifold area to insure a uniform flame distribution.

Case 1, Turbulent Flow

In the turbulent-flow region, which usually extends over the first portion of the burner length, the friction factor may be expressed empirically as a function of the Reynolds number by the following type of equation:

$$f = \frac{b}{(N_{re})^n} \quad (2)$$

where b and n are numerical constants. This a form of the familiar Blasius relationship

$$f = \frac{0.3164}{4(N_{re})^{.25}} \quad (2a)$$

The final design equation which shows how the hydraulic radius of the distributing manifold should vary with distance along the burner is shown in *Equation 3* (see page 45.)

Fig. 1 is a plot of the design *Equation (3)*, showing the variation of the hydraulic radius with distance along the manifold for various values of the parameters $L/4\,m_o$ and $Q_0/\nu L$. Curve 1 in *Fig. 1* is an example of a set of conditions which would require a line burner to have an increasing then a decreasing manifold area from the inlet to dead end.

Case 2, Laminar Flow

At some distance from the dead end the Reynolds number will drop below 2100, and the flow through the manifold will be in the laminar region. In this case the friction factor will vary inversely as the Reynolds number

$$f = \frac{16}{N_{re}} \quad (4)$$

The final design equation for this flow region is

$$m = m_o \left(\frac{L - x}{L}\right)^{\frac{1}{2} \cdot B} \quad (5)$$

where

$$\beta = \frac{4\,a\,\nu\,\pi\,L}{Q_o}$$

If $\beta = \frac{1}{2}$, the area of the manifold remains constant. If $\beta < \frac{1}{2}$, the diameter decreases with the distance x. If $\beta > \frac{1}{2}$, the diameter increases with the distance x.

Fig. 2 is a plot of *Equation (5)* which shows how the hydraulic radius varies with distance along the burner manifold for various values of the parameter $Q_0/\nu L$.

Case 3, Negligible Friction

For this case the third term in *Equation (1)* may be neglected; and the following design equation is obtained:

$$A = A_o \left(\frac{L - x}{L}\right) \quad (6)$$

This represents a true linear taper of the cross-sectional area of the manifold with distance along the pipe. *Equations (3)* and *(5)* tend to reduce to this form as the parameter $Q_o/\nu L$ becomes very large and the parameter $L/4m_o$ becomes small.

Case 4, Manifold Serves as Infinite Reservoir

If the pressure changes accompanying the flow of the fluid through the manifold due to frictional and inertial forces are negligible in comparison to the pressure drop across the discharge ports, then the flow will be distributed uniformly through the ports. In effect, this is the case where the manifold is so large that it is equivalent to an infinite reservoir.

The design criteria for the case of negligible pressure change along the constant area manifold are

$$\frac{(\Delta p)_{\text{ports}}}{(\Delta p)_{\text{inertial}}} = 2.8 \left(\frac{A}{A_p}\right)^2 >\!> 1 \quad (7)$$

(For equations 8 and 9, see page 45.)

Equation (7) explains why a uniform flow distribution is obtained with conventional line burners if the total port area does not exceed the cross-sectional area of the manifold. However, this criterion alone is not sufficient to insure

*W. M. Dow, "The Uniform Distribution of a Fluid Flowing Through a Perforated Pipe," *Journal of Applied Mechanics*, vol. 17, pp. 431-438, Dec. 1950.

Other pertinent references to this general subject:

B. G. Van der Hegge Zijnen, "Flow Through Uniformly Tapped Pipes," *Applied Scientific Research*, vol. A3, no. 2, pp. 144-162, 1951.

J. D. Keller, "Design of Manifolds and Pipe Burners," *Industrial Heating*, vol. 29, no. 1, Jan. 1952. Ibid, Feb. 1952. Ibid, March 1952.

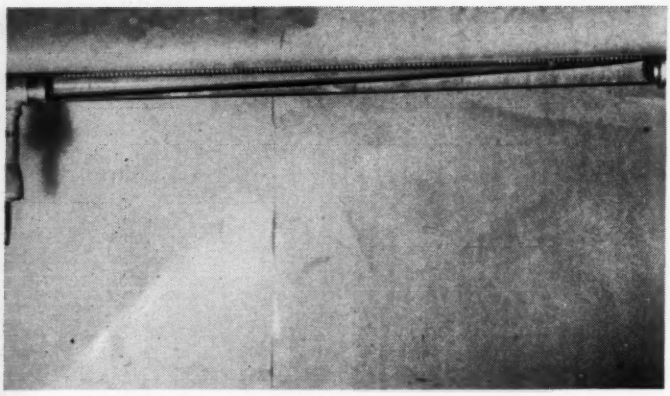


Fig. 5. Cut-away view of tapered bore burner.

Fig. 7. High capacity tapered-bore line burner.

a uniform discharge of gas as shown by *Equations (8)* and *(9)*.

Operating characteristics

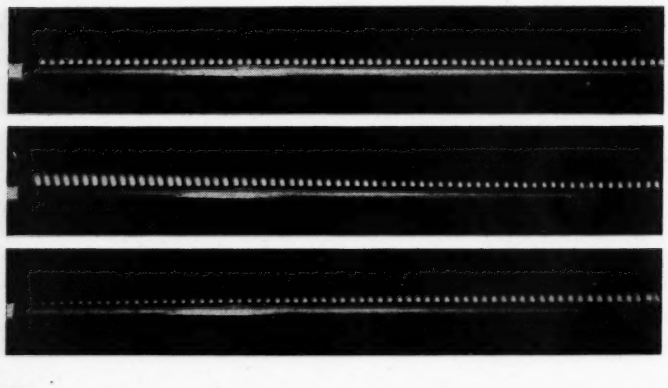
The series of photographs in *Fig. 3* show, in turn, a conventional pipe burner, which is an example of the highest capacity 2-in. diameter pipe burner commercially available; the same conventional burner with its total port area increased from 0.72 to 4.32 times the cross-sectional area of the manifold; and, finally, the same burner with increased port area but with a tapered plug inserted in the distributing manifold to provide the proper variation of the manifold area as specified by *Equations (3)* and *(5)*. The physical dimensions and operating conditions of these burners are given in *Table 1*.

As explained in the previous sections, the conventional burner in *Fig. 3(a)* satisfies the necessary criteria for the manifold to behave as an infinite reservoir feeding uniformly the discharge ports. When the total port area was made much larger than the manifold cross-sectional area, the conventional burner produced a very unsatisfactory flame distribution; but the same burner was converted to a useful and high capacity burner (approximately 600% original capacity) by the simple expedient of inserting a properly shaped tapered insert into the distributing manifold. The primary air supply was purposely reduced in *Figs. 3(b)* and *3(c)* to cause a yellow flame so that flame distribution could more easily be discerned.

Figs. 4(a) and *4(b)* show another example of a line burner which has a total port area greatly exceeding the manifold cross-sectional area. *Fig. 4(a)* shows the burner producing a very nonuniform flame. Half of the heat is being released over approximately the last foot of the 5-ft long burner. The flame height at the inlet end is only a few inches high while at the dead end it is about 4 ft high. This same burner was readily converted to a useful pipe burner, which has a uniform flame distribution, *Fig. 4(b)*, by inserting a tapered plug into the manifold. This burner has a heating capacity of approximately 10,000 Btu/hr/linear inch. The physical dimensions and operating conditions of these burners also are given in *Table 1*. *Fig. 5* shows a cut-away view of the tapered bore burner with the cast iron tapered insert in place.

Figs. 6(a, b, and *c)* demonstrate the flow principles discussed in the previous section under *Case 2, Laminar Flow*. These are not examples of commercially useful burners, but are included merely to demonstrate the fundamental flow principles discussed above. The flow of the gas-primary air mixture in the manifold is in the laminar region over the entire length of the burner in each of the three photographs. As shown by *Equation (5)* and also by curves 1, 2 and 3 in *Fig. 1*, when the flow is in the laminar region there is a single optimum flow rate *{Fig. 6(a)}* which will give a uniform flame distribution even though the total port area exceeds the manifold area. At higher flow rates, the flame height tends to increase toward the dead end *{Fig. 6(b)}*, while at lower flow rates

Figs. 6a, 6b, and 6c (below): 6a — Optimum flow rate to give uniform flame distribution with constant diameter burner. 6b — flow greater than optimum rate producing high flame at dead end of constant diameter burner. 6c — Flow less than optimum rate producing high flame at inlet end of constant diameter burner. Flow is from right to left. **Fig. 8 (top right)** is a small cast iron, tapered bore line burner. **Fig. 9 (below)** is a compact tapered-bore line burner with flame along entire length.



EQUATIONS 3,8, AND 9

$$m = \frac{L}{4}\left\{\left[\left(\frac{4\,m_o}{L}\right)^{.75} + 2\gamma\right]\left(\frac{L-x}{L}\right)^{.375} - 2\gamma\left(\frac{L-x}{L}\right)^{.75}\right\}^{1.33} \quad (3$$

$$\frac{(\Delta p)_{\text{ports}}}{(\Delta p)_{\text{laminar}}} = 0.10\left(\frac{Q_o}{\nu L}\right)\left(\frac{A}{A_p}\right)^2 \quad >> 1 \quad (8)$$

$$\frac{(\Delta p)_{\text{ports}}}{(\Delta p)_{\text{turbulent}}} = 26\left(\frac{Q_o}{\nu L}\right)^{.25}\left(\frac{A}{A_p}\right)^2\left(\frac{D}{L_1}\right)^{.75} >> 1 \quad (9)$$

it tends to decrease toward the dead end *{Fig. 6(c)}*.

Fig. 7 shows a high capacity, one piece, cast iron, tapered-bore line burner which has much better combustion characteristics than the simple, tapered-bore pipe burners. It has 5 ft of flame length, 21/64-in. diameter raised ports, and a total port area of 32 sq in. It has a maximum tested capacity of 1.5 million Btu/hour with a natural gas and 40% primary air mixture. It may be operated at lower capacities and with higher percent primary air mixtures. Its lighting, extinction, flashback and turn-down characteristics are very satisfactory.

Figs. 8 and *9* show examples of small cast iron line burners. Their physical dimensions and operating conditions are given in *Table 1*. The burner shown in *Fig. 9* is unique in that the flame extends over practically the entire length of the burner. This makes a very compact burner which requires no extra space for an external primary air mixer. The air mixer is constructed as an integral part of the burner below the first short section of flame. There is a divided gas flow towards both ends of the burner at the end of the mixer. The burner is a simple, easily constructed one-piece casting. This compact design is possible because the tapered manifold design makes it possible to have the total port area exceeding the manifold area.

Line burners similar to those described above may be manifolded together to form a bank of burners. They may be fabricated into gas grates with capacities up to 600,000 Btu/hour/sq ft of grate area to fit fire boxes of almost any size or dimension.

Significance of new burner design

This new design makes it possible to construct a gas burner with an extended flame length, uniform or controlled heat distribution, and, most important, a total port area many times greater than the cross-sectional area of the manifold feeding the ports. This last characteristic has several significant and desirable consequences:

1. High heating capacity compared with conventional burners.
2. Stable flame operation due to the high linear gas velocity in the burner manifold. No loping flame characteristics nor tendency for flame extinction.
3. Decreased tendency for flashback due to the high linear gas velocity in the burner manifold, which is of the order of magnitude of 50 ft/sec compared with a flame velocity of only a few feet per second.
4. The use of large port diameters with low escape velocities. Since the manifold velocity is approximately 10 times as great as the escape velocity through the ports, flashback through the ports is minimized and insignificant. The flashback cannot travel to the primary air orifice against the high manifold velocity.
5. Low port escape noise and no need for flame retention nozzles even for high capacity burners. This is also the result of low port velocities and high manifold velocities.
6. Large turn-down ratio.
7. Small burner manifold volume which minimizes extinction noise.
8. High heat transfer rates between the burner walls and the high velocity gas in the manifold which results in a low metal temperature.
9. A design suitable for both atmospheric and premix burners.

Summary and conclusions

Theoretical considerations of the flow through a perforated pipe have resulted in a clarification of the operating characteristics of line burners. It has been demonstrated that line burners which have a far greater utility and capacity than now realized, may readily be designed and constructed. This theoretical study has resulted in a rational guide for the design and construction of a simple and extended range line burner, which has a capacity of several hundred percent greater than commercially available line burners.

Design equations have been developed for the construction of line burners which would have a uniform distribution of heat along their length. Likewise, a burner which would have a desired but nonuniform distribution of heat along its length could be constructed.

NOMENCLATURE

A = cross-sectional area of manifold pipe at any point, sq ft
A_o = cross-sectional area of manifold pipe at inlet end, sq ft
A_p = total port area, sq ft
b = numerical constant
D = diameter of manifold pipe at any point, ft
D_o = diameter of manifold pipe at inlet end, ft
f = fanning friction factor, dimensionless, defined by relation,

$$dF = \frac{2u^2 f}{D}\,dx$$

where dF is the friction in foot-pounds per unit mass of fluid flowing for a differential length of pipe, dx

L = active length of manifold pipe, ft
L_1 = length of pipe in which fluid flow is in turbulent-flow region, ft
m = hydraulic radius, defined as cross-sectional area divided by wetted perimeter, ft
m_o = hydraulic radius at inlet end, ft
N_{Re} = Reynolds number = $\frac{4mu}{\nu}$
n = numerical constant
p = pressure, psf
Δp = pressure difference, psf
Q = volume rate of flow at any point, cu ft per hr
Q_o = volume rate of flow at inlet end, cu ft per hr
u = average velocity of fluid in manifold, ft per hr
x = distance along manifold pipe from inlet end, ft
y = distance along manifold pipe from dead end, ft
α = constant (approximately 1 for turbulent flow and $\frac{1}{2}$ for streamline flow), dimensionless
β = $4\alpha\nu\pi/Q_o$, dimensionless
$\gamma = \alpha b \Big/ \left(\frac{4Q_o}{\pi\nu L}\right)^m$, dimensionless
μ = absolute viscosity, lb sec/ft^2
ν = kinematic viscosity, ft^2/sec
ρ = density, slugs/ft^3

NEW EQUIPMENT, NEW METHOD

Blowing dust from distribution networks

By N. K. SENATOROFF and E. NIEDERER JR.
Southern Counties Gas Co., Los Angeles

DURING October 1952, dust in fairly large quantities entered a portion of the transmission and distribution network of the San Gabriel Valley division of the Southern Counties Gas Co. The section known as the Whittier-Santa Fe Springs area normally receives its gas supply from a fairly old transmission line. Apparently, due to difficulties encountered on other transmission lines of the supplier, it was necessary for this line to carry, for a short period, much larger-than-normal loads; this was sufficient to stir up large quantities of dust, which was carried over to our point of supply.

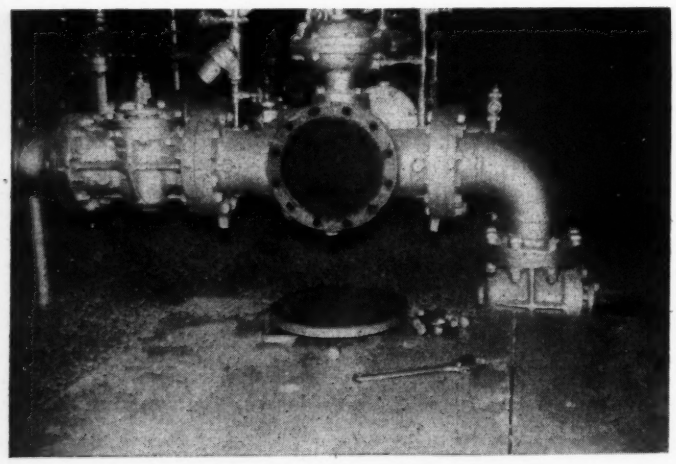
Almost immediately, our calls for pilot trouble increased from approximately five per day to over 200 in this area. A quick check of the apparent limits of the area where the calls were coming from pointed to this particular source. The source to this area was cut off and the gas delivery was provided from another transmission system.

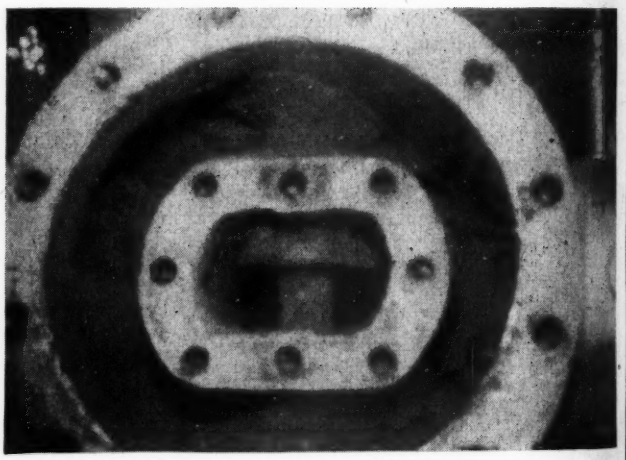
While this was accomplished within a few hours from the first noticeable increase of pilot outages, the damaging effect of dust to this section of the system was done. From the number of calls received, it was obvious that not only pilot outages but also the operation of district regulator stations in this area was affected. (Map shows the area affected and location of district regulators.)

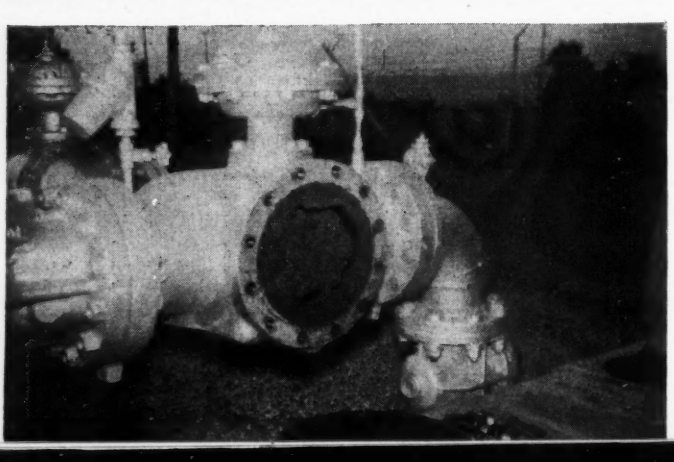
Several standard methods for removing this dust were tried by the company, but the one that proved most successful was the use of a unit specially developed in conjunction with Universal Gas Specialties Co. Composed of a steel tank mounted on a frame, screen, fish nets, cloth bag, etc., the dust unit acted to catch the dust effectively and quietly.

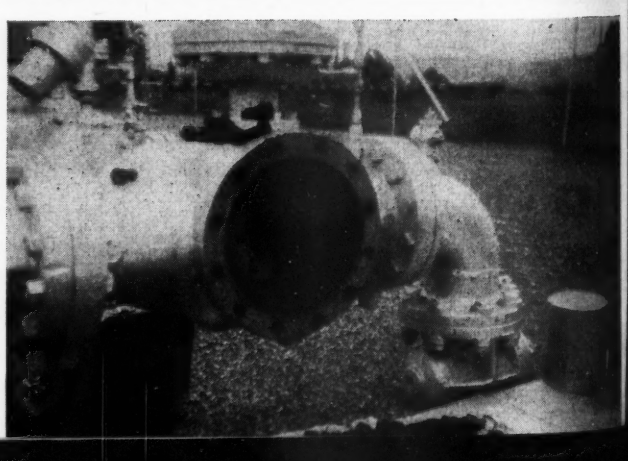
The problem and the solution: Below are various views of the dust accumulation in regulator valves and bowl which was removed by the apparatus pictured on the facing page. Three shots show the portable dust unit being connected and in operation in the field. The fourth photo in the group is of a portion of dust collected by the bag during one blowing operation. Eighty-five percent of the dust shown measures three microns or less. The map shows the affected area and the location of district regulators.

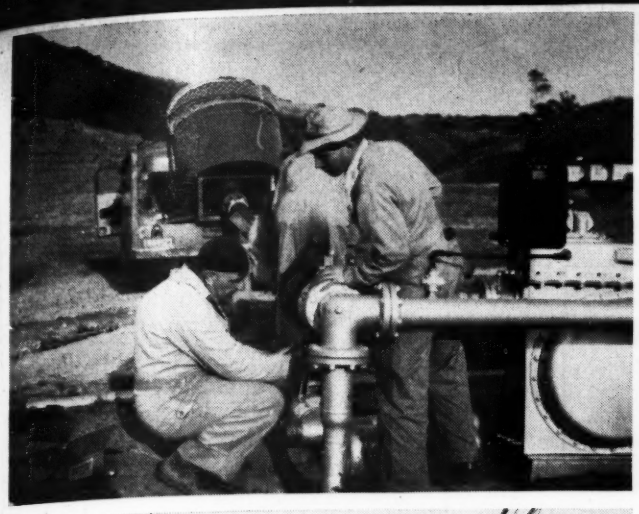
PROBLEM

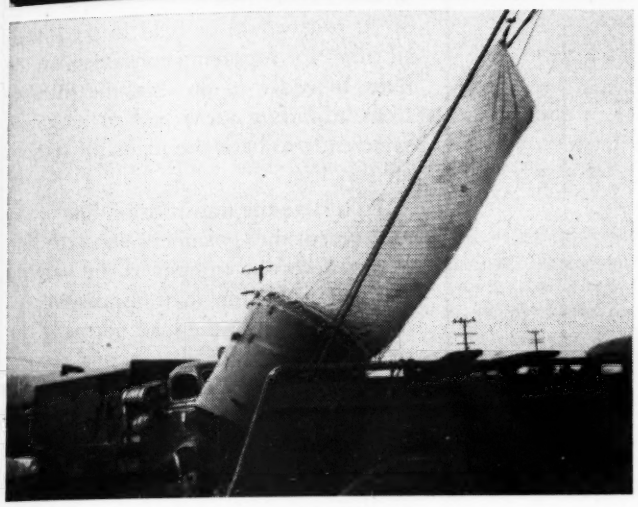


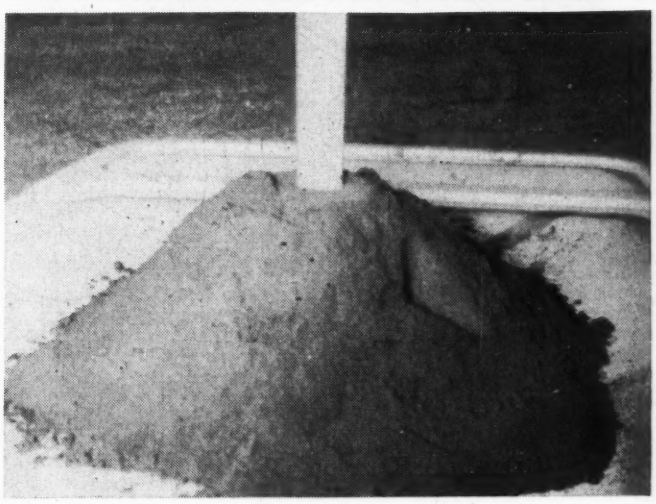




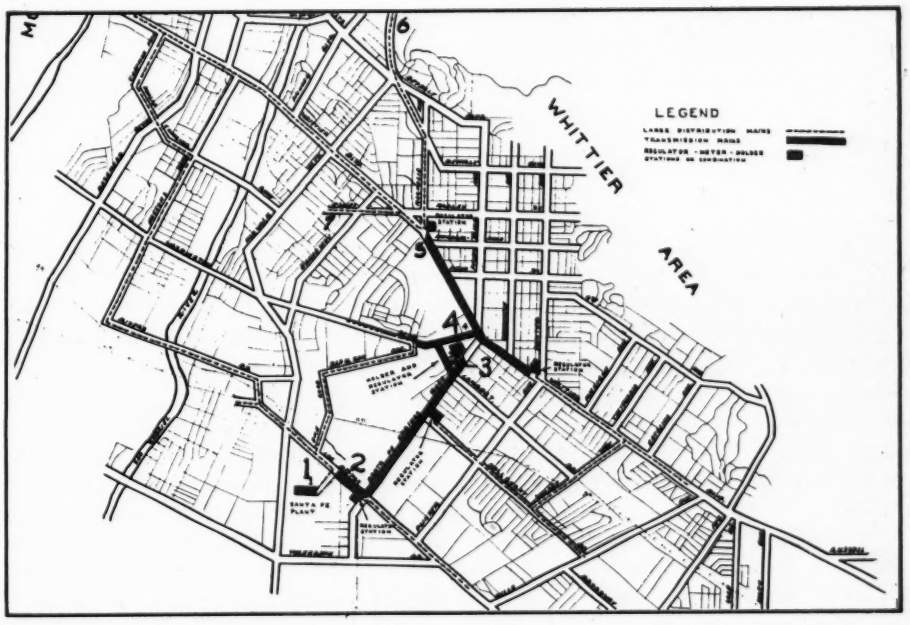








SOLUTION



Although the phase of the job in which the unit was used was performed at night and in populated areas, it brought forth no consumer complaints.

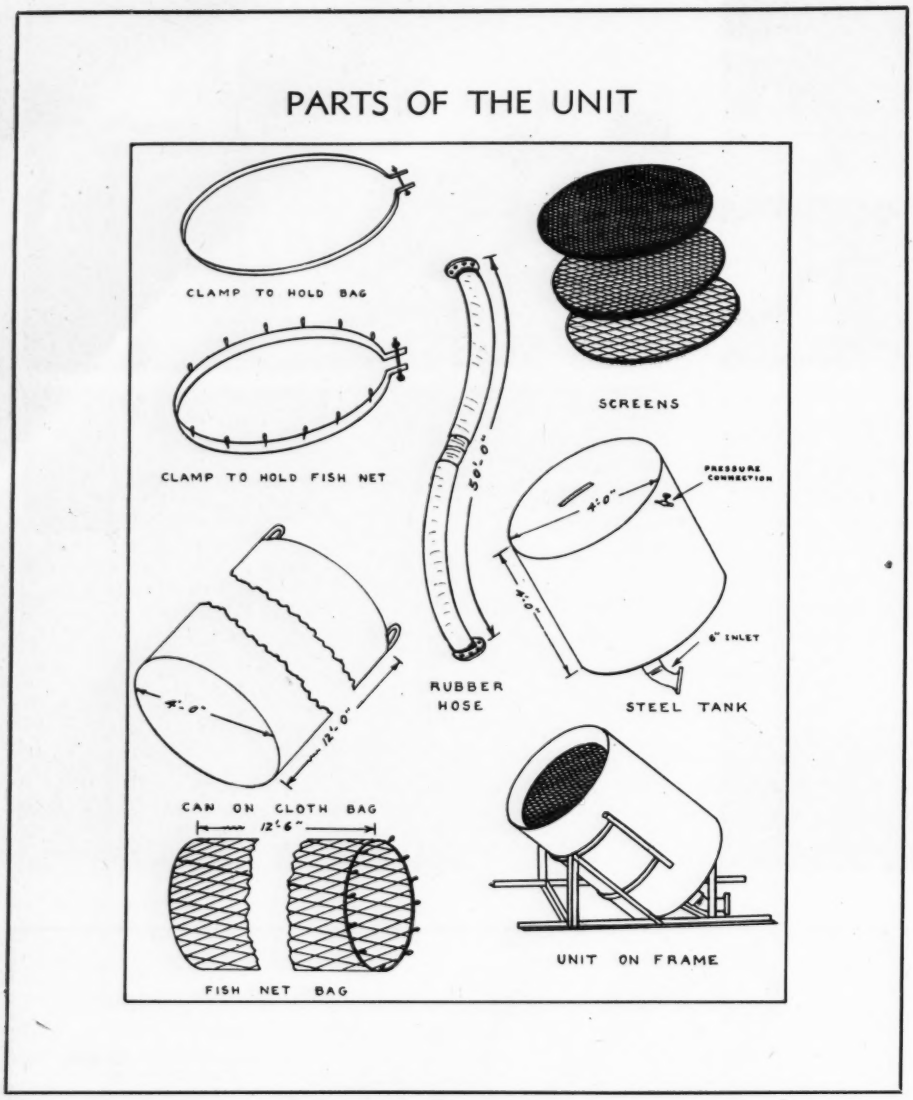
It is well known that dust, in the form of iron and silicon oxides, is a problem that the gas distribution engineer must face continually. In a system handling undehydrated gas containing oxygen and sulfur-bearing impurities, dust is constantly being formed. In an old system that has been converted from a manufactured into a dehydrated natural gas system, the process is even more evident.

Dust scrubbers, large and small filters on industrial or domestic services, and filters on individual appliances are all rendering only partial solution to the problem, because they are slow in cleaning out the system of quantities of dust accumulated there from years of distribution of manufactured gas.

Moreover, in a system undergoing expansion, where constantly increasing gas velocity is applied in order to meet the growing demand for gas, quite often the need arises to provide a method for a very drastic disposition of dust from the distribution or transmission system so as to be able to meet the customers' request for satisfactory service during peak-hour sendouts in the winter months. Such was the case in this instance.

The observed condition of the valves of the district regulators, together with the amount of dust removed, proved that large quantities of dust had not only gotten into the small transmission system supplying the affected area, but had been carried over in large quantities into the distribution system. The area consisted of both old and new services, and, although the newer services are equipped with filters, it was found that trouble was not confined to unprotected services.

This article is adapted from a talk presented at the PCGA distribution conference in San Jose, Calif., April 28-29.



Just as much trouble with pilot outages was encountered on services equipped with filters. This caused great concern until the results of laboratory tests indicated that in order to stop the very fine dust particles coming through (85% of the dust was five microns or smaller) larger filters with a different type of filtering material would have to be installed.

Several dust filters had been tested in order to determine their filtering efficiency at 8-in. w.c. gas pressure and less than .1-in. w.c. pressure drop across the filter. Of the 14 filters tested in one batch, 11 or approximately 78% were found to show evidence of dust leakage from the start. The leakage of dust was, in all cases, found at the junction of the cemented seam with the stamped flange.

As has been the experience of other companies in the past, the adjustable needle type pilot valve gave the greatest trouble.

Equipment containing fixed orifices was not affected. Winter was at hand, accompanied by increased flow in the main system, and more trouble was in store unless at least the majority of the dust in the transmission mains and large header distribution lines could be removed.

Obviously, the first thought would be to shut the line down and blow the dust out. However, there are other things that must be considered: What happens, for instance, to consumers off the line while the dust is being blown? Where should we blow the dust? What happens to thousands of consumers being fed by the transmission line, and how can they be supplied if it is down? What should be done with large distribution header lines and the maze of smaller lines connected to them?

With the physical limits of our trouble known, it was agreed that the majority of the dust was deposited in the transmission main from Point 1 to 2, 2 to 3, 3 to 4, and 4 to 5. Several methods of removing the dust from these sections of transmission lines were proposed and tried. All were planned on the basis that no consumers were to be without gas at any time. Line 1 to 3 normally is carried at pressures ranging between 100 to 125 psig. Decision was made to blow this line in sections back from the holder station at Point 3, utilizing the gas and pressure in the holders. The gas which would be used in this operation had to be blown through a stack into a large open field. The blowing of the transmission line had to be done in such a manner that a minimum pressure of 30 psig would be held in the line at all times for supplying consumers on the line. In order to do this, the pressure from adjoining areas had to be raised sufficiently to back the regulator stations off this line.

To relieve the transmission line of any load except the consumers along the line, it was necessary to convert, by valving, a distribution line to transmission, and carry on this line the load normally carried on Line 3 to 4, 4 to 5, and the city of Whittier. Because of the complexity of the operation, a detailed procedure was developed and trial run of the entire operation performed to prove or disprove estimates of what could be done with this system under actual field conditions.

It was necessary also to check the time required for the operation in order to determine leeway available for repairs if for some reason the moving of this dust should build up and plug the line at some bend or unknown obstruction. Because of public relations, off-peak loads, and ease of moving equipment, the test operation was scheduled to start at approximately 11 p.m. Radio cars and Walkie Talkies were employed in the operation.

Another method

Another method consisted of lowering the pressure in one of the holders located at Point 3, blowing the transmission line into the holder, shutting off the holder, and letting the dust settle in the holder. While this eliminated the objection of blowing dust in the vicinity of homes, the noise of blowing large quantities of gas quickly into the holder was objectionable to the consumers in the vicinity of this station.

In addition, there may not be holders available for this purpose. Besides, after such an operation, it was estimated that the holders had to be isolated from the system for a period of at least two to three weeks in order to settle the dust.

Although blowing the gas through the stack in the open field removed considerable dust, complaints about the noise and the danger of air currents carrying the dust into built-up areas were problems that had to be solved. Dust concentration tests on this line were made before and after these operations. It was determined that the blowing of the line resulted in its reduction from approximately 1 lb per 1 MMcf to .1 lb per 1 MMcf.

It was known that the transmission main sections from 3 to 4, and 4 to 5, as well as the distribution header section from 5 to 6 and 5 to 7, still contained large quantities of dust. These lines posed a more difficult problem as the entire area along and surrounding these mains is residential in nature and no source of supply within a reasonable distance was available to try and reverse the flow in line 4 to 5 back to the holder station.

Public relations considered

In trying to decide on a method of removing dust from the aforementioned lines, the foremost points that had to be considered were public relations and uninterrupted service to all consumers. One method that appeared, at first, to offer possibilities was to construct a portable oil scrubber and blow dust at various points through this scrubber. However, after considering the volume of gas involved in such an operation, the method presented considerable difficulty and expense in providing portable equipment.

It was felt that with such a scubber, the danger of blowing oil into the air, and its accompanying damage, was too great a hazard; therefore, it was decided to develop a special unit to overcome the abovementioned objections. With the assistance of Universal Gas Specialties Co., a unit as shown in the accompanying drawings and pictures was developed for the purposes of blowing dust from the mains.

This equipment was used at Point 5 and Point 6. At Point 5, connection was made to the unit at the end of the transmission main and gas pressure at other regulator stations was raised to back off any load from the regulator station at Point 5. This then relieved all load from line 3 to 4, 4 to 5, other than the consumers off this particular line.

Line 3, 4, 5 normally carries a pressure of 55 to 60 psig. Gas was blown into the portable unit at the rate of approximately 350,000 cu ft per hour. The unit was then moved to Point 6, which was at the end of a distribution header. Gas pressure was raised from other regulator stations to relieve as much as possible any load on this line and the gas was blown into the unit at the rate of approximately 150,000 cu ft per hour. The quantity of dust removed from these mains by the last two operations is shown in the accompanying picture.

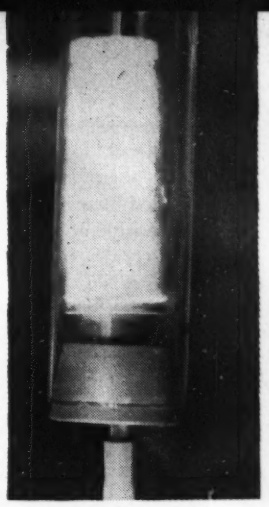
WHAT HAPPENED TO THE FILTERS

The unit, as shown in the drawing, consists of a 4-ft diameter steel tank approximately 4 ft long; a 50-ft, 6-in. flexible reinforced rubber hose connected at the bottom, which in turn, is connected to the gas main; three screens evenly spaced, each screen having a different diameter diamond shaped opening, and the wire making up the screens so shaped that the screen serves two purposes: (1) as the gas passes through the screen, it has a tendency to swirl the gas and more or less create centrifugal force to throw the dust into the sides of the container; (2) to stop any large objects such as stones, steel shaving, etc., from damaging the cloth bag. The bag portion is attached by means of a clamp to the top of the steel tank, and is 4 ft in diameter and 12 ft long. The bag is made of Canton flannel. Over the bag is a fish netting composed of No. 48 twine, 4½-in. stretched mesh with a breaking strength of 96 lbs. The fish netting is bound with rope at the bottom and clips attached to a clamp around the steel tank.

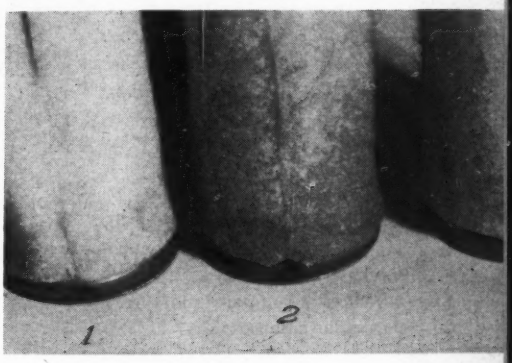
High rate of flow

It is estimated that with a longer bag, 16 ft long, in place of the 12-ft, and covered with the described fish netting, a rate of at least 1 MMcf per hour can be blown through the bag with only a 2-in. to 3-in. differential. With the fish netting over the bag, this high rate of flow can be put through the bag and collect dust safely until the differential is in the neighborhood of 5 in. w.c. Should the differential rise above this point, there is danger not from breaking the bag, but a higher differential would then have a tendency to force some of the finer particles through the flannel.

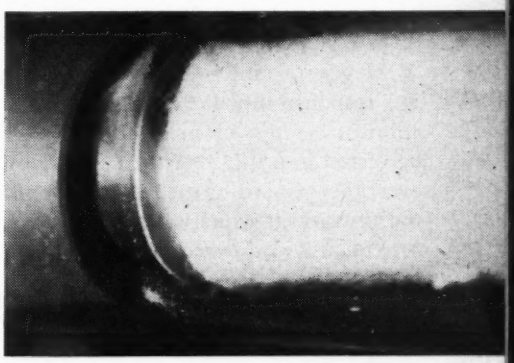
The results of these tests were satisfactory and plans are in process to conduct further operations in other old sections of our system known to contain dust.



Filter in tube under test with show of dust at center line of tube.

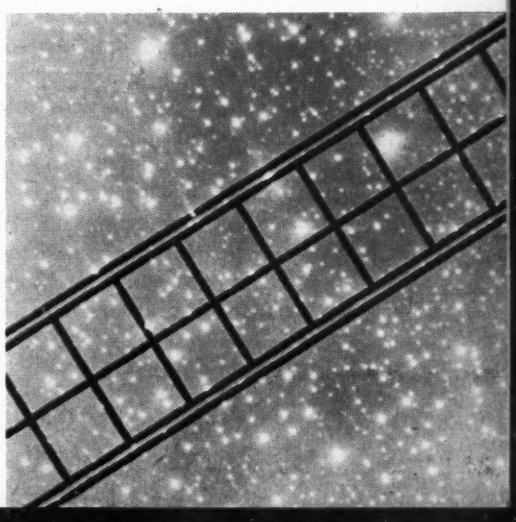


Three filters after test showing point of leakage. No. 1, dry; No. 2, oil soaked; No. 3, water soaked.



Close-up of filter under test showing swirl of dust around edge of sack on glass tubing.

Dust particles viewed through microscope. Maximum particle size is 15 microns.



Restoration of gas facilities in civil defense emergencies

By **HOWARD C. YOUNG** • Federal Civil Defense Administration

Experiences in World War II presented a useful object lesson for gas utilities in the United States: while bombs and rockets are capable of causing complete disruption of service, wise and intensive advance planning may in many instances limit the extent of destruction to temporary shutoffs.

London and European and Japanese cities are studies in contrast. In the latter cases, gas service was many times completely lost, and the fuel needs of hospitals, field medical stations, and mass care centers could not be supplied. In London, however, while bomb and rocket attacks caused great havoc to the gas system, adequate advance planning resulted in prompt repairs and maintenance of service.

Advance planning among gas utilities in the United States will take many forms, each plan being designed to meet a company's individual specifications. Nevertheless, each company's plan should become an integral part of the overall civil defense program.

This study, prepared by the Federal Civil Defense Administration with the assistance of a gas facilities advisory panel*, describes the basic pattern for utility operation, from which each company should adapt its own particular defense plan.

*Members of the advisory panel: A. V. Brashear, Michigan Consolidated; E. R. Cunningham, Texas Eastern Pipe Line; Joseph C. Fletcher Jr., Sun Oil; A. B. Huyck, Brooklyn Union; E. Clyde McGraw, Transcontinental Gas Pipe Line; and George H. Smith, AGA.

IN general, the field and operational responsibility for emergency restoration of gas service in emergencies will be vested in utility managements. However, the responsibility for determining the priority in which emergency service is to be provided rests with the state and/or local civil defense director, and utility managements will cooperate in restoring service to the maximum extent of their capabilities.

The gas utility's emergency operational program should be planned by a gas utility liaison representative on the staff of the local civil defense engineering services chief.[1] Responsibility for restoration of the gas service should remain in the gas utility, and the liaison representative chosen by the utility because of his special knowledge of the industry and wide acquaintance in the community will be responsible to the civil defense director for coordination of the emergency repair and operation of gas utilities. He will usually have several assistants, their number depending on the number of utilities serving that area; there should be one assistant for each gas utility company, preferably drawn from each company. Employees of the local gas utility will form the nucleus of the gas service. Repair and operating crews would be augmented by other volunteers where practical.

Gas utility service areas are usually widespread and often inconsistent with political subdivision boundaries, and they are often operated under centralized direction and control. Because of this, planning between utility companies and civil defense officials should extend upward through appropriate political levels within the state, and be tied indirectly with interstate mutual aid pacts. Such an arrangement will insure a close understanding of the "chain of authority" during an emergency and avoid confusion in the transmission of messages.

Gas utilities should maintain close liaison with other utilities, such as power and water, and with other civil defense services such as fire, police, communications, transportation, warden, health, and welfare. Only through cooperation with all these groups can effectiveness in time of civil defense emergency be assured.

Mutual aid and mobile support

Mutual assistance among gas utilities within the state should be given primary attention. For the large interconnected companies mutual aid and mobile support plans would consist mainly of their standing agreements to send into the disaster area all possible assistance in the way of personnel, equipment, and supplies from the company's nonaffected areas. However, mutual assistance between the smaller gas companies requires much more consideration. Gas utility companies should arrange meetings with representatives of other gas utilities in their area. At these meetings maps of the respective utility company plants can be studied and exchanged, and emergency connections and mutual back-up plans for obtaining alternate gas supplies from other sources explained. Where the facilities of two or more utilities or supplying companies cross or are in close proximity to each other and a study indicates that interconnections would be helpful, such additional interconnections should be arranged.

The FCDA manual, *Principles of Civil Defense Operations*[2] contains recommendations regarding the furnishing of state mobile support by the state director of civil defense. Under this program, if the sectional civil defense officials cannot supply needed assistance in time of emergency they call on the mobile support groups within the state for the necessary aid. The resources of the entire state could thus be made available if needed. Gas utility companies, through the engineering services of the civil defense organization, should be represented at the state level so they will know what help is available to them from such sources. Mutual aid between neighboring gas utility organizations of adjoining states may become necessary and desirable. Such need should be provided for in the mutual aid pacts of the several states.

While it is impossible to forecast accurately how destructive new weapons are, a general knowledge of their probable effects will help gas utilities in their pre-emergency planning.

The atomic blast[3]

Destruction from the blast. The collapse of buildings over a large area would fill streets with debris. Based on the experience in Japan, there would be comparatively few broken gas mains. The number of breaks, however, would depend upon the type of ground in the area, the depth of the mains below street grade, and the amount of debris in the streets over the mains. On the other hand, there would be widespread destruction of gas services and house lines within the various buildings in the area. The total area of damage from an A-bomb

[1] *Engineering Services*, AG-13-1, 1952, FCDA.

[2] *Principles of Civil Defense Operations*, AG-8-1, 1950, FCDA.

[3] Authoritative background information on the effect of the atomic bomb on people and structures may be obtained in the publication, *The Effects of Atomic Weapons*, U. S. Department of Defense and U. S. Atomic Energy Commission, September 1950.

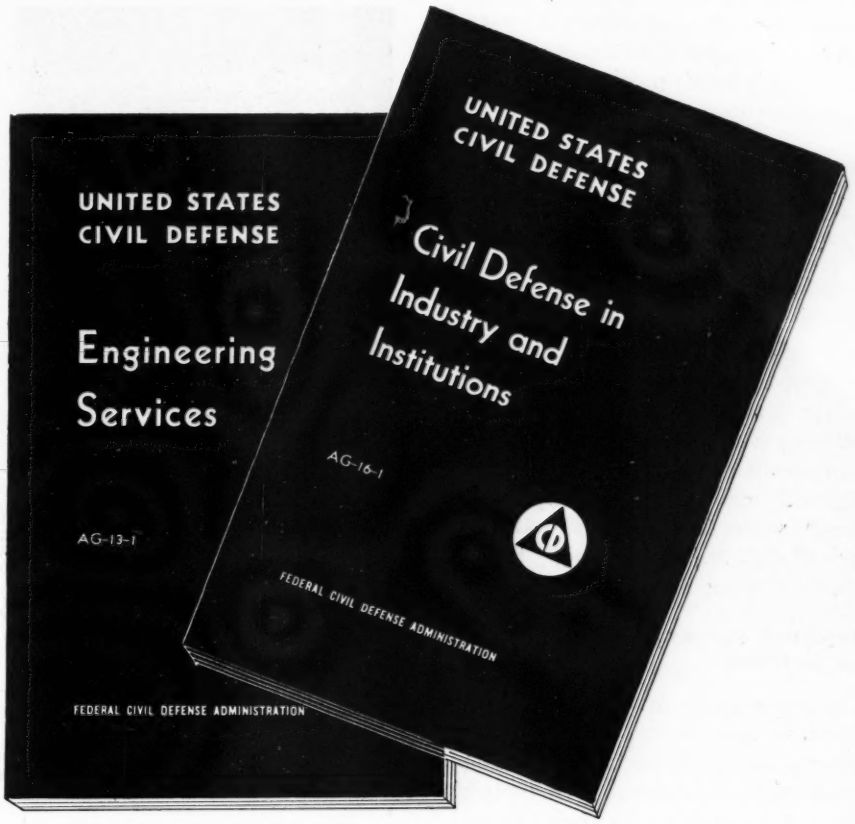
like that used in Japan (20,000 tons TNT equivalent) would probably extend 12,000 ft or more from ground zero. In Nagasaki, gas tanks were heavily damaged by blast at 6600 ft. The escaping gas was ignited but there was no explosion. Gas mains suffered no observable damage except where exposed under bridges. If a 2½X A-bomb (50,000 tons TNT equivalent) were used, the area of destruction would probably extend about 16,500 ft from ground zero.

A low-altitude or surface burst would produce more severe structural damage, although the area of damage would be smaller. It is estimated that with a 2½X A-bomb surface burst, all gas utility structures within the crater area, which might be about 1400 ft in diameter, would be either completely destroyed or badly damaged. Very serious damage would result to utility facilities outside the crater area due to the vibrations caused by the impact and burst. Furthermore, all underground gas mains and service lines in the crater would be badly broken.

The possibility that some gas mains might be sealed off by water should be noted. Disturbance of a building might result in breaking both the water and gas lines and filling the basement with water, which in turn would flow into the gas system when the head of water became sufficient to offset the few ounces of gas pressure in the distribution system. If this happened around the periphery of the damaged area it might seal off a number of gas mains, making the immediate cut and blank-off action normally required difficult if not impossible. Similar sealing off of gas mains might occur where outside and adjacent gas and water mains were broken. Water in subsurface structures, such as basements and vaults, would make it difficult to close valves located in those places. Pressure regulators located in pits might also be damaged by water.

Fire. Heat radiated by an atomic burst of great intensity but short duration may start many fires. Fire could also be started indirectly by blast, which ruptures gas mains and creates electrical short-circuits. Fires of this type might occur at much greater distances from ground zero than those caused by heat.

In time of emergency, gas escaping from broken mains and services would add greatly to the fire hazard, while water lost from broken mains and services would weaken the defense against fire losses. The rapidity with which such losses are stopped will depend upon the effectiveness of the mobilization program and the pre-emergency preparation made to meet such emergencies.



Two key guides for gas industry defense preparations are the booklets on "Engineering Services" (AG-13-1) and "Civil Defense in Industry and Institutions" (AG-16-1), both published by the Federal Civil Defense Administration. The former describes the functions, organizations, and responsibilities of the various types of engineering services such as gas utilities, contractors, public works departments, etc. in emergency operations. "Civil Defense in Industry and Institutions" presents recommendations for setting up "self-protection" programs for industrial plants.

Radioactive contamination. Residual radiation from an atomic air burst occurring about 2000 ft aboveground would be a negligible hazard. A low-altitude or ground level explosion, however, would probably cause a considerable degree of radioactive contamination.

Other weapons

While our main concern is with atomic weapons, there are other instruments of warfare that must be considered. High explosive bombs, for example, are still a force to be reckoned with: when used in large numbers, the overall effect may be roughly comparable to that of an atomic bomb as far as blast and fire damage are concerned. Blast damage to buildings would be more localized, however.

Incendiary bombs are also highly destructive, as are guided missiles, which are either high-explosive or atomic type.

Attempts at sabotage must also be anticipated.[4]

Minimizing effects of enemy attack

Certain measures, such as dispersion, duplication, personnel shelters, and underground construction are known to reduce the effectiveness of enemy attack by minimizing casualties and equipment damage. These vary in degree of protection and likewise in cost. What is best for one situation may not be best for another. A careful study of each gas system is required to determine where one or more of these measures can be adopted with advantage.

Dispersion of production, employing the military measure of using space for defense, is highly effective in reducing a plant's vulnerability. When facilities are being added, dispersed sites should be seriously considered. Even where pro-

[4] *Principles of Industrial Security*, by Facilities Protection Board, Washington, D. C., July 1952, is a digest of the many pamphlets and reports published by Government agencies and private authorities on this subject. *Security Principles for the Petroleum and Gas Industries*, which supplements that publication, is of particular interest to gas utility management personnel.

duction is dependent upon a limited number of processes, management should consider the isolation of individual units or the provision of alternate units.

Protective construction

A study of *The Effects of Atomic Weapons* will show the effects of blast on structures. In some cases, stiffening of the frame against the lateral component of the blast may be possible to reduce the chance of collapse. Probably the most important contribution to protection that can be made in existing buildings is the reduction of the hazard from missiles. Examination of the structure will indicate fixtures, equipment, curtain walls, false ceilings, and other parts of the building that might become dislodged by the blast.[5]

Preattack survey of gas facilities

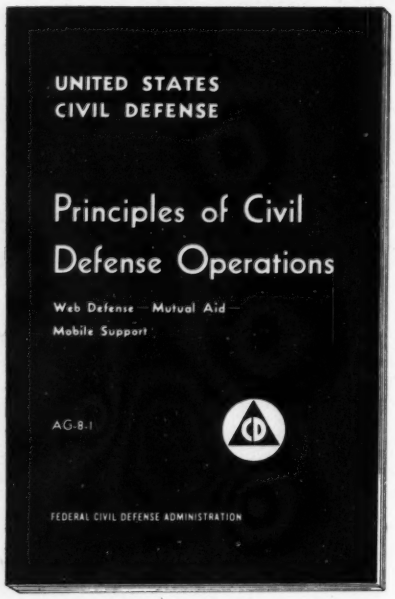
In preparing to meet wartime disaster conditions gas utilities, in cooperation with the local civil defense organization, should make an analysis of the probable effects upon their utility from the various types of enemy attack.[6] Such analysis will provide basic data for determining existing weaknesses and changes, additions of improvements required to place the gas distribution system under emergency operating conditions. If improvements are found to be necessary, construction or installation should proceed as rapidly as possible under existing conditions.

Preparation before attack

After the survey has been completed, gas utility officials can proceed to make plans for strengthening the company's ability to meet a wartime emergency and for the steps they would take to restore service. No matter how carefully the defense and restoration program may have been planned, the results achieved in time of crisis will depend upon the organization previously designated and trained to perform this work.

Emergency organization

The present line organization of the utility company should be used for the new emergency organization, with assignments of additional duties and responsibilities to selected personnel at strategic locations in the system. The gas utility liaison representative in the civil defense organization should work closely



A manual for key workers in civil defense is provided in "Principles of Civil Defense Operations" (AG-8-1), covering web defense, mutual aid practices, and mobile support.

with the gas utility's civil defense coordinator. In some cases the coordinator's civil defense duties may be "collateral," but large gas utilities will be justified in appointing a full-time civil defense coordinator. He should develop the company's civil defense program, including all measures to be placed in effect immediately upon declaration of an emergency.

The utility civil defense coordinator should prepare an organization chart showing graphically the line of authority and the assignments of all defense personnel and alternates for persons in the critical target area.

Company coordinators should supply the local civil defense authorities, through their liaison representative, with information concerning the gas utility's facilities, assignments of key personnel in the emergency organization, where they probably could be contacted in an emergency and the best method of communicating with them day and night. A schedule of operations to insure 24-hour work coverage should be included in the plan.

Civil defense coordinators should plan to augment the number of service restoration crews. Arrangements should be made for experienced members of regular maintenance and repair crews to serve as foremen of new emergency crews. Usually several times the normal number of crews will be required for the civil defense emergency repair organization. The probability of 50% casualties among emergency restoration personnel should also be taken into account in calculating manpower requirements.

All employees physically qualified to be helpful in the program should be given emergency assignments regardless of their department or the type of work they normally perform. By means of an employee questionnaire the coordinator can ascertain what special skills the employees possess. Gas utility employees should be advised not to join any other civil defense group but to keep themselves available for emergency work with their own company's organization should a major disaster occur. Likewise, the utility's engineering and maintenance equipment, communications, vehicles, and other specialized facilities should be reserved for use in utility restoration work. Gas utility personnel not having a defense assignment in the gas utility plan should be encouraged to volunteer for other civil defense duty.

If none already exists, the company coordinator should institute a self-protection program[7] in the utility's main office building and large plants with a building coordinator in charge of each building, including a warden service to direct workers to safe areas in event of attack, a fire service responsible for fire prevention and fire-fighting, and a first-aid service, a rescue service and other special protective groups if the size of the building warrants it. He should select personnel shelter areas in all buildings in target areas, post appropriate signs, and hold practice exit drills. He should also give consideration to providing a separate air raid warning system in the key plants of the system.

Training of personnel

Once the emergency program has been developed, arrangements should be made for training the utility employees in the duties of their assigned positions so all employees will know how they fit into the civil defense program and be able to take up their new assignments with a minimum of confusion or delay.

Personnel assigned to the civil defense emergency organization should receive basic first-aid training as well as instruction on the organization, purpose and functions of civil defense. *The American Red Cross First-Aid Text Book* has been supplemented with special material on the care of attack victims. Key instructors should be trained when possible by the American Red Cross.

[5] *Interim Guide for the Design of Buildings Exposed to Atomic Blast*, TM-5-3, June 1952, FCDA.

[6] *Urban Analysis*, TM-8-1, July 1953, FCDA.

[7] See *Civil Defense in Industry and Institutions*, AG-16-1, 1950, FCDA.

All civil defense workers should be required to read the FCDA booklet, *Survival Under Atomic Attack*.[8] The FCDA cards describing individual protective measures to be taken against atomic attack should be obtained and distributed to employees. Additional training material relating to the detailed operation of the utility in a civil defense emergency should be prepared by the utility and incorporated into their regular employee training program.

Since a utility's main office is usually located in the business section of a city, and a likely target area, an alternate office from which business could be conducted should be designated. A part of the staff and equipment might be permanently moved to such a location.

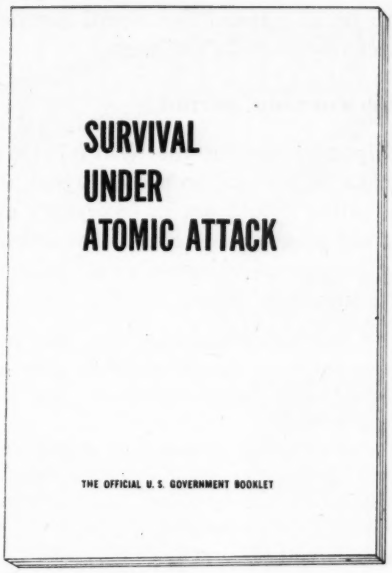
Similarly, in addition to the reporting and dispatching centers normally used, each utility should make provision for one or more emergency centers which could be utilized promptly if required.

Communications

The success of the entire emergency program may depend upon having adequate communications, so no effort should be spared in developing plans for alternate means of receiving reports, dispatching orders and summoning assistance in event the usual means of communications are disrupted. In the case of larger utilities these plans should provide for decentralized operations by districts until normal means of communication are restored.

The commercial telephone company can provide efficient communications if informed in advance regarding the utility company's emergency requirements so they can effect line load control and security measures where necessary. It should be anticipated, however, that some telephone communications facilities would be destroyed in a major disaster, so plans should be made to bridge possible gaps with alternate wire or radio communications.

Intra-company communication by radio has proved itself to be a valuable asset for gas utility operation in emergencies. To increase this service in existing systems additional radio equipment of the same frequency could be installed in the more important sub-stations. Each utility or supplying company having a radio communications system should obtain a receiver for each of these fixed stations capable of receiving on the frequency of any adjacent utility or supplying company so that inter-company communication could be maintained in time of disaster. Because of the importance and value of fixed radio stations, it is suggested that these companies purchase power generating equipment to take over in the event of local power failure to insure these stations being on the air at all times.



The widely distributed "Survival Under Atomic Attack" (NSRB Doc. 130) is the bible of protection for the individual.

Maps and records showing all operating facilities should be brought up to date and completed as rapidly as possible. A safe repository should be provided for corporate records such as contracts, leases, drawings, diagrams, plant and engineering records, and maps. Duplicate records should be made—micro-filming is recommended—and stored in bomb-resistant repositories together with viewing equipment. Copies should be sent to state and neighboring communities for safe-keeping and mutual aid uses.

Customer priorities

If gas service facilities are badly disrupted, gas supplies would probably have to be curtailed and rationed on a priorities basis. The relative priority generally is decided by the local civil defense director and/or the state civil defense director. In a few states, however, service would be allocated and restored in accordance with the priority orders of the public service commission.

Priority planning for disaster should be part of pre-emergency plans of local civil defense organizations and their gas utility representatives. Hospitals, food storage and processing plants, municipal and government agencies, welfare centers and other vital facilities would necessarily receive higher priority ratings than customers less essential to the national defense.

Each utility should review its present stocks of material, which would likely be based upon peacetime maintenance and repair needs, and consider adding stocks of items most likely to be needed for emergency repairs or rehabilitation. Critical items should be procured immediately, where practical. Quantities required will vary, of course, depending upon conditions and the prospects of mutual aid and mobile support.

The dispersal concept should also be considered. Additional storage yards might be established on the perimeter of target cities. Vehicles, as well as tools and equipment, might also be dispersed.

Liquefied petroleum gas

L. P. gas could be used effectively for cooking, water heating and refrigeration in hospitals, first-aid stations, and welfare centers in civil defense emergencies should their normal gas supply be disrupted.

Local civil defense officials should compile lists (names addresses and telephone numbers) of all persons in their community connected with the L. P. gas industry, noting particularly those trained for handling L. P. gas equipment, cylinders and appliances. A copy of this list should be sent to the state civil defense director for use in case the original is lost or destroyed. Where considered advisable, city or natural gas appliances might be made available as a pre-emergency measure. Provision can also be made for training a limited number of installation and servicemen, and outside volunteers, in L. P. gas appliance conversion work and for their transportation in case of emergency.

Arrangements should be made for each L. P. gas distributor in the area to submit periodic reports showing approximate number of L. P. gas systems, cylinders and appliances that would be available in time of need. Such records should include the large storage tanks, and the capacity and location of each. Copies of these inventories also should be sent to the state civil defense director.

Instructions for gas customers

Hand-bills, cards, or pamphlets describing the action gas users should take to assure safety in event of attack should be prepared and mailed to them at in-

[8] *Survival Under Atomic Attack*, NSRB Doc. 130, 1950.

tervals with their monthly bills. Arrangements should be made with the local civil defense public information division and suggested announcements prepared in advance for imparting information to the general public promptly when occasion demands. For example, when an attack is imminent, gas customers might be instructed, through press or radio, to turn off their gas range burners and non-automatic gas appliances such as manually operated water heaters or room heaters, but *not* to turn off the gas at their meters or at pilot lights. They should also be instructed to close the valve at the service entrance or meters if the building becomes damaged or the gas supply fails. The cooperation of the civil defense warden service should be enlisted in carrying out this public information program.

During emergencies the progress being made in restoring gas service should be broadcast frequently so residents will know the gas company is making repairs and obtain some idea of when service will be resumed.

All company emergency workers should be provided with appropriate office and plant passes, arm-bands, windshield stickers or other means of vehicle identification, to allow their movement on streets and highways during an emergency.

Gas utility operational plan

An operational plan should be prepared in advance for each gas utility in the city and coordinated with the city's over-all operational plan. It might be included as an annex to the total plan, or as a numbered appendix to an annex covering all the utilities in the city.

The operational plan should describe the action to be taken *automatically* upon the various warnings which may be expected as well as at the time of attack. It should describe the basic assumptions on which the plan is formulated (i.e., the anticipated number, size, and type of bombs; the probable location of ground zero; the expected time of bombing, etc.), and should state in general terms the plan for automatic operations. It should include detailed statements of the parts to be played by the various units of the organization, stating as clearly as possible "who is to do what, and when and how."

It is possible that advance notice will not be received in time to warn gas utility personnel before an attack. The emergency restoration program must, therefore, be so planned that it will function effectively without an "alert."

The warning period

Upon receipt of the WARNING YELLOW (attack probable) signal, the gas utility should put its emergency operating program into effect. The following basic steps common to all gas utilities should be taken:

1. Gas utility personnel with civil defense functions should take their posts at civil defense control centers or other assigned stations.
2. Gas utility personnel in offices and field headquarters should be notified immediately, and each employee should proceed to his assigned emergency station.
3. Repair and operating crews should be instructed to go to their predesignated emergency locations or to assume special preassigned duties.
4. Prepared messages containing detailed instructions relative to the use of gas should be released to the public by civil defense public information channels. The public should be advised to notify their civil defense block wardens if their gas pressure fails; the wardens, in turn, will transmit this information to the local civil defense control center.

When WARNING RED (attack imminent) sounds, utility officials and all others should take cover and stay under cover until WARNING WHITE (all clear) is heard indicating that the attack is over or that an attack is improbable.

Action after attack

After an enemy attack, personnel in charge of each gas utility facility should report the facility's condition to utility headquarters. As this information is received at headquarters, the general condition of the gas system may be determined. If necessary, alternate operating headquarters should be activated. Headquarters should establish contact with the appropriate civil defense control center and keep the gas utility liaison officials informed of all changes in the situation. Utility headquarters should take appropriate action on the following:

1. Condition of gas service to hospitals, first-aid stations and mass care centers;
2. Extent of damage to production facilities (if any), distribution and transmission lines, and broken services in the bombed area;
3. Availability of gas services;
4. Zoning off devastated areas to conserve gas and minimize the likelihood of fires;
5. Damage to mains outside devastated area;
6. Movement of parts, supplies and equipment needed for emergency operations;
7. Movement of available mobile L. P. gas units with experienced L. P. gas mechanics to welfare centers, hospitals, hotels, restaurants and other critical facilities needing emergency gas supplies; and
8. Requests for mutual aid or mobile support. (Request this aid through the gas utility liaison representative at the control center.)

If the pre-attack planning has been adequate and the gas utility's emergency organization functions as intended, a speedy assessment of damage to gas facilities will be made. Reports will come in to the local civil defense control center by telephone, radio, or messenger regarding the condition of the system. Reports will also come in from other civil defense services, particularly health and wardens, concerning the availability of gas service at hospitals and other essential community facilities. These data should all be charted in the main control center on a large scale map of the local utility's distribution system located in front of or near the utility liaison representative. By reference to this map, that official can quickly give accurate damage reports and other information to the utility company personnel and answer customers' questions intelligently regarding restoration of their service.

As soon as possible after the emergency restoration program has begun to function, the chief of engineering services or his gas utility representative at the main control center should advise all the other civil defense services concerning the availability of gas service.

Field exercises

After a utility has completed its civil defense plan, it should conduct a field exercise with all other civil defense services to determine the plan's adequacy under emergency conditions. This should be carried on under the direction of the local CD organization, in cooperation with mutual aid and mobile support groups. The local CD director will advise assumptions to be made during the hypothetical emergency. Following the exercises a complete report should be prepared setting forth the results obtained, any weaknesses revealed in the emergency plan by the exercises, and the requirements for placing the program on a more practical and workable basis. Similar field exercises should be conducted at reasonable intervals in an effort to develop the operations to a point where the gas utility can feel confident of carrying out satisfactory procedures.

THE EMPIRE GAS FLOOR FURNACE Can't Be Beat

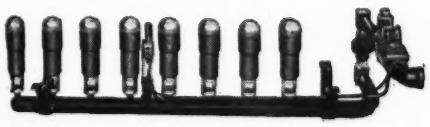
SILENT AS A KITTEN WITH AN EXTRA SET OF FOOT PADS!

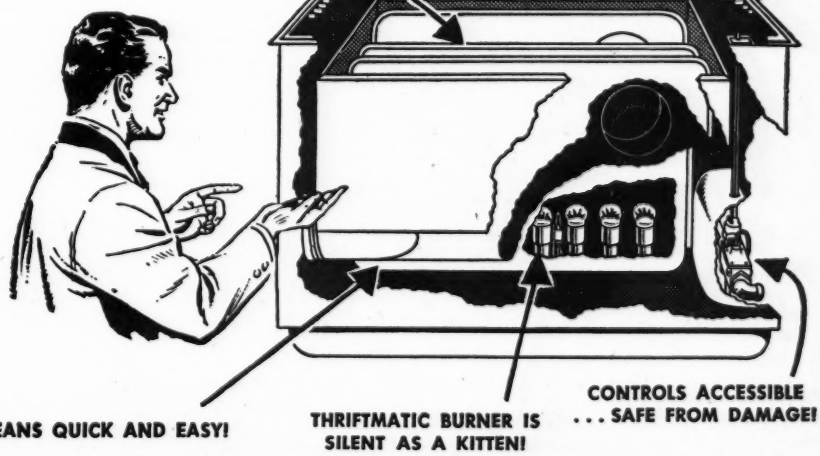
Make extra sales with the furnace that has all these features!

Just a glance at the Empire Gas Floor Furnace will immediately tell you why it sells so easily . . . and **stays** sold to build big volume **repeat** business for you.

NO BOOM! NO BANG! NO TICK!

The FAMED "Thriftmatic" Gas BURNER




NO FUMES . . . HEALTHFUL HEAT!
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CLEANS QUICK AND EASY!
THRIFTMATIC BURNER IS SILENT AS A KITTEN!
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WORLD'S LARGEST MANUFACTURER OF *Gas* FLOOR FURNACES

Thermally Thinking

Continued from page 28

cent months allowing more than a 6% return—the order of Aug. 7 allowing a $10 million rate increase to United Fuel Gas Company, Columbia Gas System subsidiary.

While the order ostensibly was not designed to establish any general relaxation of previous earning restrictions or to set up a new general policy for all cases in the future, it still held out hope that the FPC will adopt a more realistic policy in the future.

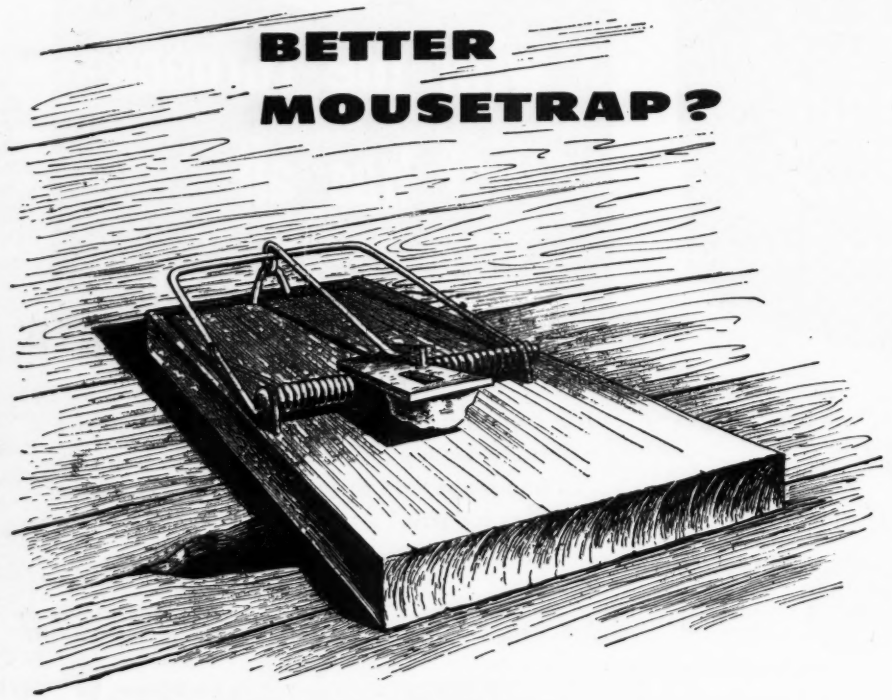
The majority opinion itself stated that there were "special circumstances" in the Columbia Gas System to justify the 6¼% return allowed.

"Columbia has resisted the lure of an undue thinning of the equity and has maintained a conservative capital structure," the opinion stated. "Return should be sufficient to encourage continuation of this practice."

Neither Chairman Kuykendall nor Commissioner Digby (the new Eisenhower appointees to the FPC) took part in the United Fuel Gas decision, but they are said to have concurred heartily in the majority decision. The dissenting opinion of Commissioner Dale Doty also was believed to be quite favorable to the new policy, for he held out only for a 6% return (which is higher than usual) and stated that this return should not be "based primarily on the so-called bare-bones cost of money to the Columbia system." This is a strong hint that even he is abandoning the strict cost-of-capital theory as the exclusive measure of the rate of return to be allowed gas companies. This policy recently was condemned by the 8th U. S. Circuit Court of Appeals in the Northern Natural Gas Co. decision.

FPC also has issued other orders that indicate the "cost-of-capital" theory is being discarded, if it ever were a fixed policy of the commission, and commissioners consistently have denied that it was.

FPC accepted a settlement providing an increase of some $8.5 million for Texas Gas Transmission Corp., yielding revenues about $2 million less the service cost claimed by the company but still based on the alleged six per cent return.



The story of the reward for a better mousetrap is proverbial. But the fact remains that most mice are still caught by this simple, economical and effective contraption.

Gas purification is a parallel case.

Iron Sponge, preferred for the removal of H_2S seventy-five years ago, is still preferred today. And for these same reasons . . . simplicity, economy and effectiveness.

Iron Sponge operates with high efficiency at high or low pressures, has excellent capacity and activity, gives long service between foulings and is simply and quickly regenerated.

CONNELLY Inc.

Northern's victory incomplete

The new look in FPC rate thinking evidence in the United Fuel Gas case took some of the steam out of the eighth circuit court of appeals' decision in the Northern Natural Gas Co. case. The court tossed the decision back to FPC on the basis that the 5½% cost-of-money determination was based on "insufficient" findings. It is noteworthy that, although in some quarters the court's verdict was hailed as a victory for the gas transmission industry, the

"SALES CLINCHERS" FOR GAS RANGE SALESMEN

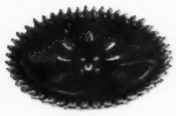
No. 6 of a series

To sell her the *GAS* range, show her the *SELF-RELIGHTING* feature of the

ALLTROL® *Center Simmer*

Let the customer *prove to herself* there's nothing so wonderful as that gas range* equipped with Alltrol Center Simmer. Turn the valve handle; let her hear it "click" into Center Simmer position. Ask her to blow the flame out, so she can see how it relights—automatically. It sells her more than a thousand words!

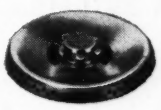
ONLY ALLTROL BURNERS HAVE A *COMPLETE* HEAT CYCLE



Full flame Starting Burner for quick boil or fast frying.

A full range of intermediate heats when wide spread of heat is needed.

Click . . . here's efficient "Center Simmer" that maintains boiling in any covered vessel.



Click . . . a gentle "Keep Warm" heat . . . without further cooking.

**Write for names of ranges featuring ALLTROL Center Simmer.*

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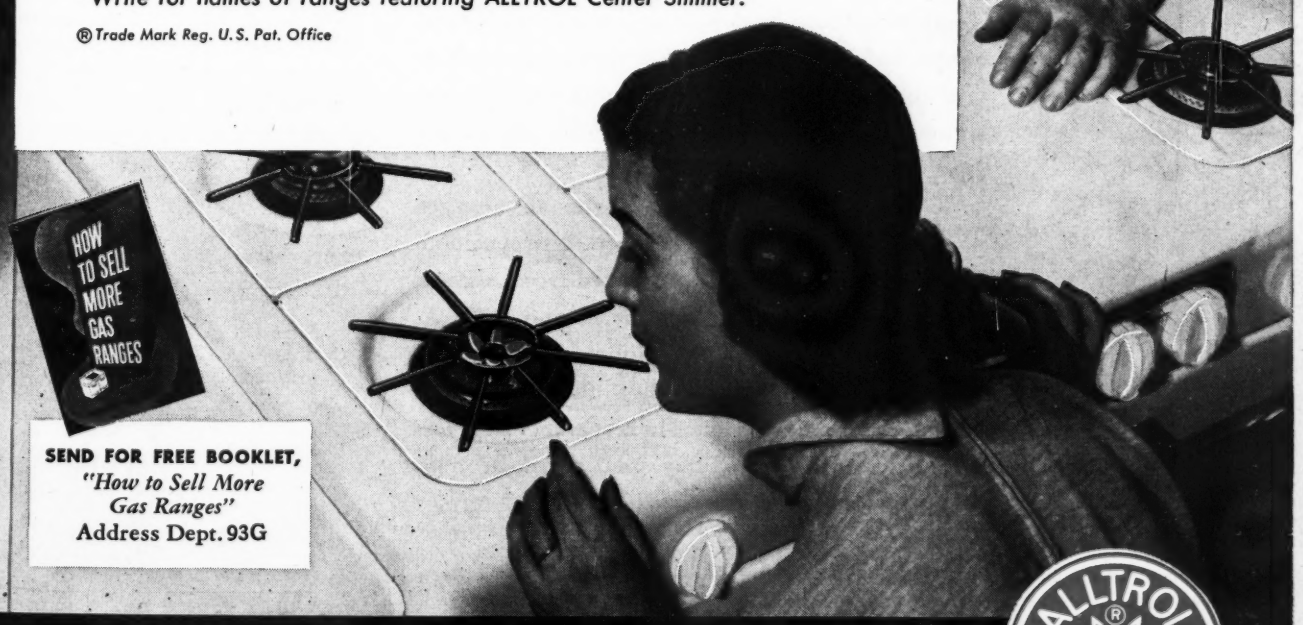

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ALLTROL® CENTER SIMMER

Thermally Thinking

court merely stated that "no rate of return determination can be set out so meagerly and have conclusive value." Apparently, should FPC come forth with more conclusive evidence that would satisfy the court, the 5½% could still stand.

On the other hand, it would seem safe to asume that FPC was holding nothing back, so presumably it would have no further arguments that were not already documented. Furthermore, with a new makeup and an apparent change in philosophy among the older members, FPC now might be expected to give Northern a better break.

Rather easily overlooked in the general jubilation over the upset is the fact that on other counts, FPC was upheld. The court "found no error" in the "commission's exercise of jurisdiction" in suspending certain proposed industrial schedules; in FPC's refusal to accept the 8-cent Kansas valuation order; in the commission's method of allocating costs between jurisdictional and non-jurisdictional business; in FPC's findings with respect to interest during construction; in its allowance for working capital; in its dismissal of Northern's third rate increase filing; and in its findings on minimum billing demand.

Copies of the 68-page decision are hard to come by because of the tremendous demand, but for anyone able to borrow a copy the court's opinion—too long to be reviewed in these columns—is well worth study.

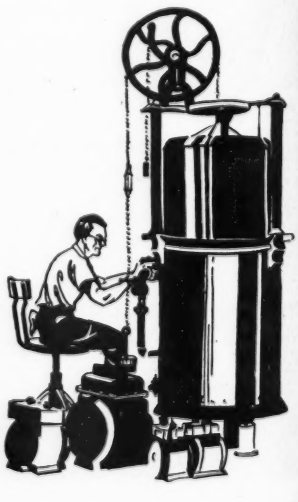
PR struggles toward its goal

Considering how little each individual company's subscription totals up to, it's disheartening to note that AGA's public relations program is still not over the top. A number of companies were prompt to sign up, yet the fund is still some thousands of dollars short of its minimum goal.

The public relations committee and other association powers, at last report, were standing pat on their original decision to scuttle the works if support fell below the minimum. The next couple of months will tell the tale.

Just offhand, we'd think utilities would feel a little self-conscious to think that GAMA can do it, INGAA can do it, the oil industry can do it, the tilemakers can do it, but they themselves can't. The price tag for comfortably sized, multi-million-dollar concerns with maybe 100,000 meters is somewhat less than the annual salary of one third-rate clerk-typist in the public relations department. If they have a public relations department.

Or a new Chevvy—without Powerglide, delivered east of the Rockies.

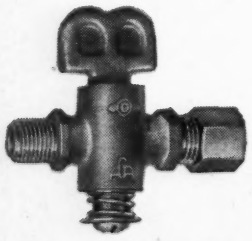


VALVES
For The GAS
HEATING INDUSTRY

Main shut-off valve, No. 2,000
Sizes: ½", ¾", 1", 1¼", 1½".

For...Furnaces...Conversion Burners...All Heating Equipment

Pilot valve, No. 1920
⅛" x ¼" c.c.



Pilot valve, No. 1910
⅛" x ¼" c.c.

These are only two of the complete line of pilot valves currently being supplied to the industry.

Continued expansion of the Gas Heating Industry will be dependent in part on the maintenance of the present high level of customer satisfaction. That's where valves come in—valves that can be depended upon to withstand torque and abuse—valves that won't talk back to you through customer complaints—valves designed to assure satisfaction for the life of the equipment.

These are some of the advantages gained when "Detroit Brass" valves are specified. Detroit Brass Valves are produced from highest quality brass, strongly constructed and A. G. A. approved. Produced by a pioneer company in the gas valve field, they bring to the user the advantage of long experience in research, engineering and field testing. They spell satisfaction to you and your customers.

Gas Appliance Fittings produced by Detroit Brass & Malleable Co. include a complete line of valves for ranges, water heaters, space heaters, furnaces and all other types of gas equipment.

GAS VALVE DIVISION
DETROIT BRASS & MALLEABLE CO.
DETROIT 9, MICHIGAN

Communist machine-gun fire dropped him in combat. But whole blood kept him alive, saw him through the hospital. He thanks you for his life.

She'd been exposed to polio. A new serum, *Gamma Globulin*, made from blood, helped ward off the dread disease. She thanks you for her life.

A tornado whipped suddenly across her home town. She was badly injured by falling debris. But a quick operation, several transfusions pulled her through. She thanks you for her life.

Three grateful people say: "we're HERE... because you were THERE!"

Each one of these people is alive today because someone gave blood.

If you've given blood before, you know how easy it is—how quick and painless. And you know what a wonderful feeling it is when you realize that what you've done may give another person his life.

Now you are asked to give blood . . . again and again. And you can do it safely every 3 months.

Because America's need for blood has increased enormously—for our armed forces, for accident and disaster victims at home, for new disease-fighting serums.

Many a life hangs in the balance! Will you help? Call your Red Cross, Armed Forces or Community Blood Donor Center today!

BUSINESS EXECUTIVES CHECK THESE QUESTIONS

If you can answer "yes" to most of them, you—and your company—are doing a needed job for the National Blood Program.

- ◯ HAVE YOU GIVEN YOUR EMPLOYEES TIME OFF TO MAKE BLOOD DONATIONS?
- ◯ HAS YOUR MANAGEMENT ENDORSED THE LOCAL BLOOD DONOR PROGRAM?
- ◯ HAS YOUR COMPANY GIVEN ANY RECOGNITION TO DONORS?
- ◯ HAVE YOU INFORMED EMPLOYEES OF YOUR COMPANY'S PLAN OF CO-OPERATION?
- ◯ DO YOU HAVE A BLOOD DONOR HONOR ROLL IN YOUR COMPANY?
- ◯ WAS THIS INFORMATION GIVEN THROUGH PLANT BULLETIN OR HOUSE MAGAZINE?
- ◯ HAVE YOU ARRANGED TO HAVE A BLOODMOBILE MAKE REGULAR VISITS?
- ◯ HAVE YOU CONDUCTED A DONOR PLEDGE CAMPAIGN IN YOUR COMPANY?
- ◯ HAVE YOU SET UP A LIST OF VOLUNTEERS SO THAT EFFICIENT PLANS CAN BE MADE FOR SCHEDULING DONORS?

Remember, as long as a **single** pint of blood may mean the difference between life and death for **any** American . . the need for blood is **urgent!**

NATIONAL BLOOD PROGRAM

GIVE BLOOD

...give it again and again

Abstracts

IMPROVEMENT OF OIL GAS SUBSTITUTABILITY FOR NATURAL GAS BY PRESSURE GASIFICATION (An IGT Interim Report)—Oil gases were produced at the Institute of Gas Technology from typical gas-making oils at cracking unit pressures of one to four atmospheres absolute to determine the effect of pressure gasification on oil gas composition and substitutability for high-methane natural gas. These gases were tested on several critical burners after the true oil gas had been diluted with a synthetic blast blow-run gas (20% carbon dioxide, 80% nitrogen) to a heating value and specific gravity that would maintain the rated heat input to the burners.

The data for oil gases produced at atmospheric pressure are compared with the results of the preceding study of the substitutability of oil gases modified to a constant heating value. The results of the combustion tests are reported as the maximum percentage oil gas in the oil gas-base gas mixture which maintained satisfactory burner performance. Gas compositions and substitutabilities are presented as functions of the true oil gas heating value at oil gasification partial pressure levels of 0.75, 1.0, 2.1, and 2.9 atmospheres, to demonstrate the effectiveness of pressure gasification as a means of increasing oil gas substitutability over a range of true oil gas heating values of 900 to 1500 Btu/scf.

The effects of gasification pressure on the Btu recovery, make oil requirements, gas yields, tar yields, and compositions and carbon formation for typical oils are also presented as functions of the true oil gas heating value at various pressure levels. These data serve to extend the published study of high-Btu oil gas production at atmospheric pressure, and provide the basis for an economic analysis of pressure gasifications as a means of natural gas substitute production.

SHELL MOLDING — Information Letter No. 53 issued by the metals committee of the AGA's industrial and commercial gas section, is a summary of the fundamental operations involved in a relatively new foundry practice, shell molding, which involves heat and, therefore, is a process that should be familiar to the industrial engineer.

The shell molding process involves the mixing of a fine silica sand and phenolic resin, and transferring this mixture to a metal pattern which has previously been heated; the mixture of sand and thermosetting resin fuses, because of the heat of the pattern, forming a shell on the surface of the pattern. The pattern, together with its shell, is then heated for the final cure. After the curing cycle, the shell, now strengthened to a hard crust, is stripped from the pattern. Each shell formed by the above operations may represent one-half of a mold, or the two halves of a mold. After the two halves have been assembled the mold is ready for pouring.

This light mold replaces the bulk cope and drag section of conventional sand molds and offers many advantages such as closer tolerances, better castings, and greater production.

CRACKING CATALYST ACTIVITY IN THE PRESENCE OF HYDROGEN SULFIDE—Prepared by H. A. Dirksen, H. R. Linden, and E. S. Pettyjohn of the Institute of Gas Technology.

Catalytic cracking of propane and other hydrocarbons of low molecular weight, especially natural gas, has achieved industrial importance as a method for producing utility gases. Emergency conditions, economic factors or depletion of hydrocarbon sources may necessitate charging sulfur-contaminated stocks, materials not now useable because of loss of catalyst activity due to sulfur poisoning.

The search for a highly active, sulfur-resistant catalyst for cracking propane was conducted among the many known catalysts for related reactions. Nickel, iron and cobalt of Group VIII, chromium, molybdenum and tungsten of Subgroup VIa, and vanadium, columbium and tantalum of Subgroup Va,

No Longer is it Necessary to Invest in Dual Fuel to Utilize Gas.

just *Add* gas!

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REVOLUTIONARY
PACKAGED RECTILINEAR* GAS BURNER

The Packaged Rectilinear makes four inches pressure do the work of four pounds with fractional horsepower.
You can fire gas — automatically — through any narrow opening without disturbing your present firing equipment — hand or stoker fired coal, oil or whatever it may be.

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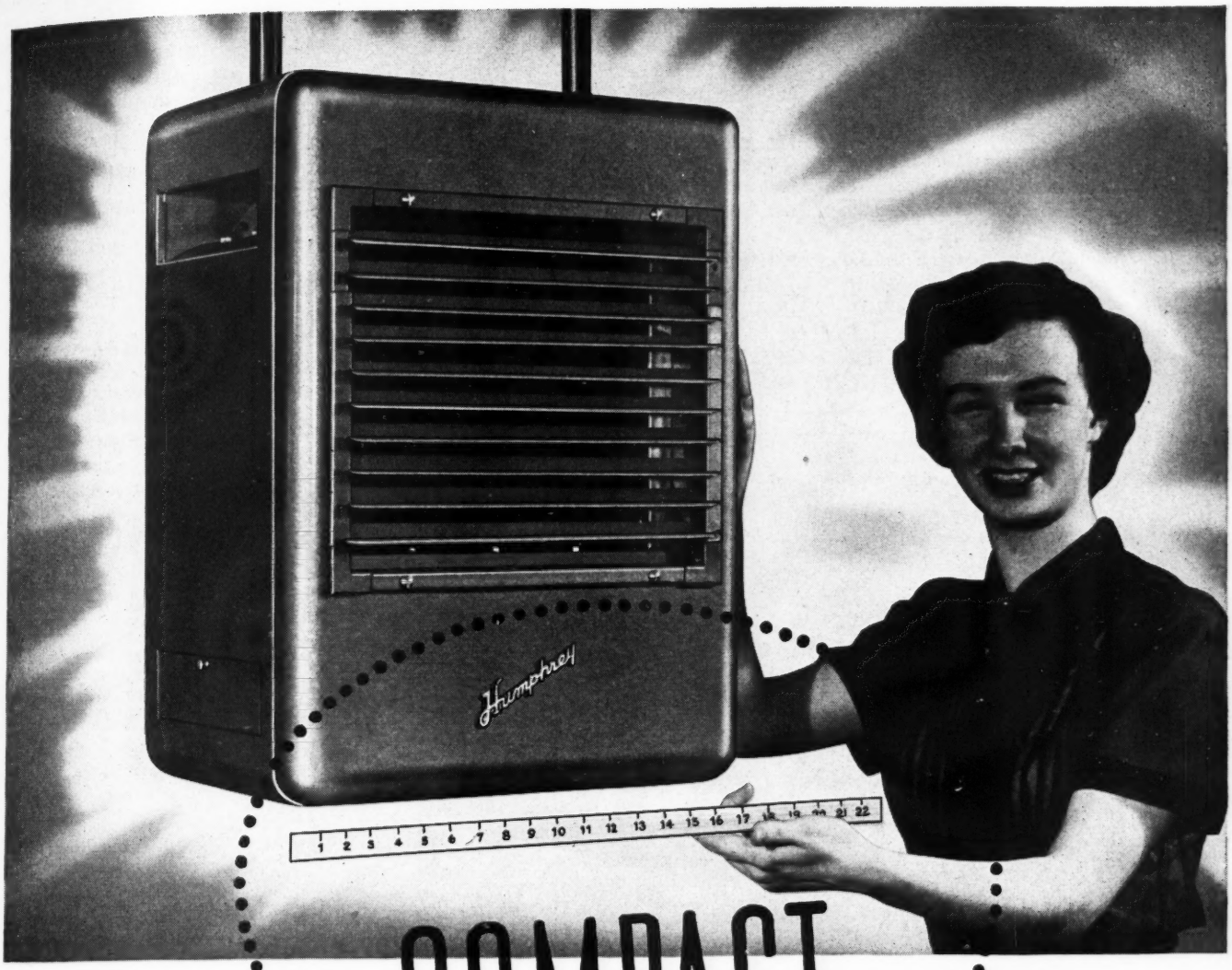


Presenting the COMPACT Model 40-G

Humphrey Automatic Gas Unit Heater

HUMPHREY PRODUCTS

With — Non-clogging Pilot . . . Tilting Front . . . Universal Burner . . . Six-Flue Heat Exchanger . . . Rear Vent . . . Dynamically and Statically Balanced Fan . . . Built-in Fan Control . . . Quiet, Heavy Duty Fan Motor . . . and Full Safety Controls.

Here's the new addition to the great Humphrey line of Automatic Gas Unit Heaters. It's the Model 40-G, a small size, moderate capacity, economically priced unit that's ideal for those many smaller offices, shops, garages, filling stations, etc.

The 40-G provides 40,000 b.t.u. input capacity in a cabinet that is only 17″ x 22⅜″ x 13¼″. It is a handsome unit, with its baked, hammertone enamel finish, and it is superbly built, with many exclusive Humphrey features.

The 40-G has a cast iron, raised port, universal type burner; Humphrey exclusive stainless steel, non-clogging pilot; exclusive tilting front; new six-flue heat exchanger of special heat and corrosion resistant high tensile alloy steel and positive, dependable safety controls. Approved for 6″ clearance at top and sides.

Write for free literature giving full details and specifications.

GENERAL GAS LIGHT COMPANY • KALAMAZOO, MICHIGAN

with thoria and zirconia of Subgroup IVa as promoters, were prepared in sulfide and oxide forms on various supports in a "standard" 1:3 mole ratio of catalytic substance to support, and in other ratios, and subjected to a "standard" test procedure to measure their activities without and with the addition of sulfur in the form of H_2S.

Nickel in its various forms was found to be the most promising catalyst for the steam-propane reaction, followed by molybdenum. Iron, chromium and cobalt were generally less active. The sulfide forms of these catalysts were normally more active in the presence of H_2S than the corresponding oxide forms.

A study of the effect of molar concentration of catalytic material to support material indicated that an optimum catalyst-to-support ratio existed.

Further studies showed that mixed catalysts tended to show no improvement in activity over that of the higher activity component, but had somewhat greater sulfur-resistance.

ROOM AIR DISTRIBUTION RESEARCH FOR YEAR-ROUND AIR CONDITIONING—This paper was presented by members of the staff of the University of Illinois at the 59th annual meeting of the ASHVE in Chicago. It was prepared by S. F. Gilman, H. E. Straub, A. E. Hershey, and R. B. Engdahl.

The initial results of a research project concerning room air distribution for residential year-round air conditioning are presented.

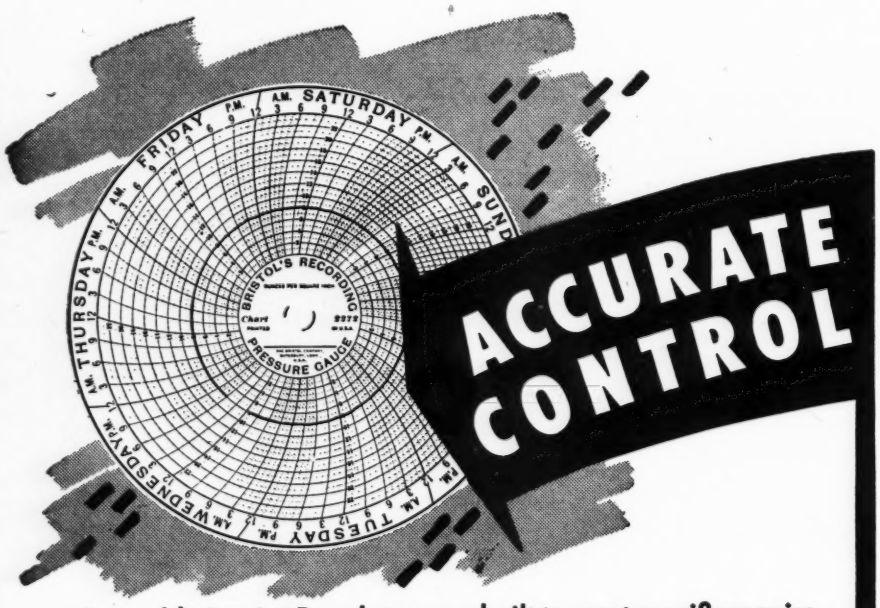
With several types and sizes of supply outlets at one high sidewall location, studies of the air distribution in a test room were made under both summer cooling and winter heating conditions of operation. The effect of varying the flow rate and velocity of the supply air, the type and deflection setting of the supply outlet, and the location of the return intake are discussed.

The next phase of the air distribution research project will deal with floor registers of both the conventional and perimeter types at various locations in the test room.

SUMMARY REPORT ON MECHANISM OF THE WATER-GAS REACTION—Prepared by Carl J. Lyons and John F. Foster of Battelle Memorial Institute.

A fundamental study of the reaction between steam and carbon has been made in an experimental water-gas generator with a cross section of 1 sq ft. Data gathered from this reaction bed indicate that almost all of the steam is decomposed and the water gas is produced at temperatures above 2100° F. The rate of reaction, at temperatures above 2100° F, increases with an increase in steam-flow rate in a manner that suggests that the reaction is controlled by the rate of mass transfer of steam from the main gas stream to the carbon surface. However, there is a critical Reynolds number, that is a function of both the steam flow and the size of the fuel, above which the reaction rate no longer increases with an increase in flow rate. It is believed that at this critical Reynolds number there is a transition from a mass-transfer controlling mechanism to a surface-chemical-reaction controlling mechanism. At temperatures below 2100° F, the rate of reaction between steam and carbon is slow and is a function of the temperature, indicating that the reaction rate is controlled by a surface-chemical mechanism.

It appears possible to use expressions developed from the data obtained in this investigation to predict the conditions of steam flow and fuel size that will result in the most nearly complete consumption of steam. It is also possible to predict, qualitatively, the effect of steam-flow rate on capacity and on sensible heat losses in the gaseous products and the undecomposed steam.



Reynolds Service Regulators are built to meet specific requirements—years of operation in the field through a complete range of operating conditions have proved not only their superiority but their durability. With parts so precisely machined for each model that they are completely interchangeable. The accuracy you require in performance is assured.

MODEL 10

Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accessible as to be interchangeable without removal from pipe line.

MODEL 20

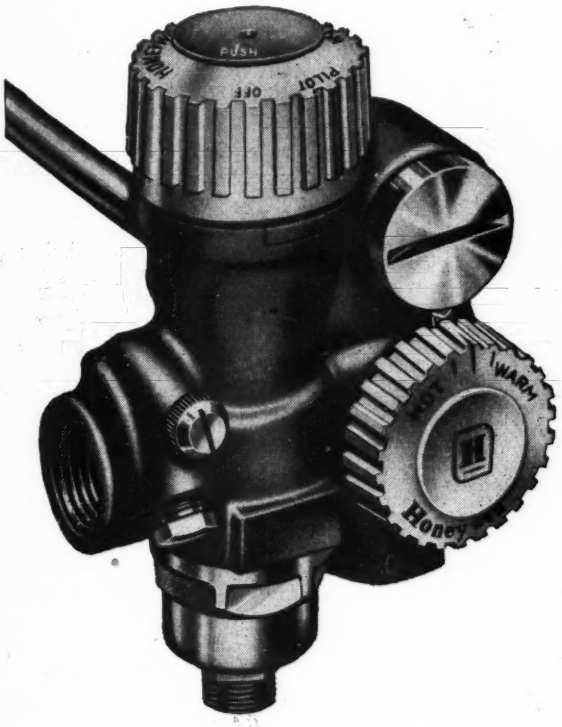
Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accurate as to permit complete interchangeability in shop.

MODEL 30

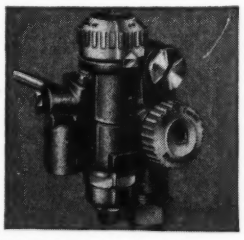
For horizontal or vertical connections, with or without removable valve pocket. Available with either Spring or Dead Weight adjustment. With or without Mercury or Dead Weight Safety Seal or diaphragm operated relief valve.

Reynolds Gas Regulator Co.
ANDERSON, INDIANA, U. S. A.
GAS CONTROL SINCE 1892

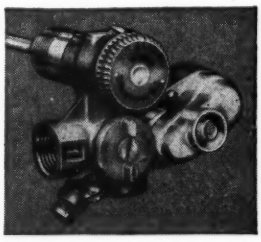
Honeywell Controls add important sales features to your gas water heaters



The "20"—Model V-5120 is the star performer in this big new line of Honeywell water heater controls. It provides *complete 100% control* for natural, manufactured or LP gas! Main gas cock with pilot position, main burner pressure adjustment and the thermomagnetic pilot with 100% shut-off are all included in this compact control.



The "21"—V-5121 is designed to take up minimum space for use as a concealed control. It includes main gas cock with pilot position; main burner pressure adjustment; thermomagnetic pilot with 100% shut-off.



The "19"—Use V-5119 for natural or manufactured gas. (Not for LP gas.) Includes thermostat; main gas cock with pilot position; pilot adjusting screw; main burner pressure adjustment; thermomagnetic pilot.

"Honeywell design" distinguishes these controls from all others! The world's leading manufacturer of precision controls—Honeywell—carefully designed these controls to maintain selected temperatures *constantly;* to light the burner *safely* and *automatically;* to provide "positive shut-off" in case of pilot failure.

Another standout feature of Honeywell Controls is the *rigid quality control test* each must pass before shipment. This assures that precision-made Honeywell Controls will give top performance when installed! Often this helps reduce the number of service calls received for minor adjustments.

You'll find Honeywell-equipped heaters have an *extra* sales feature, too! Prospects know the name Honeywell stands for quality and accuracy, and thus they're *easier to sell!*

Next time, order Honeywell-equipped water heaters! Then watch these *fast-selling, trouble-free* models boost your gas water heater profits! Call your distributor for all the facts—or mail the coupon below for literature.

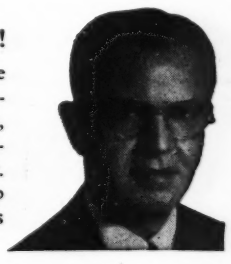
MINNEAPOLIS
Honeywell

H HONEYWELL

First in Controls

Another extra! Styled by Henry Dreyfuss!

Red and white dials plus smart styling give these new Honeywell Controls *extra* sales appeal! Nationally famous industrial designer Henry Dreyfuss, working with Honeywell, helped make these controls a smart, attractive addition for any water heater. That's why Honeywell-equipped models reflect top quality at first glance—stand out from other models on your sales floor.



MINNEAPOLIS-HONEYWELL REGULATOR CO.
Appliance Controls Division
8775 Mettler Street, Dept. GS-9-174
Los Angeles 3, California

Please send me detailed information on your complete line of gas hot water heater controls.

Name.....

Address.....

City..... *Zone*..... *State*.....

New Products and Trade Literature

To secure further information on products or new literature, simply fill out the coupon and mail, indicating by number the information or literature needed.

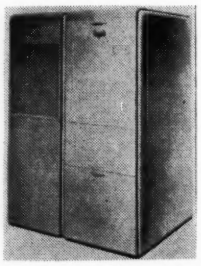
1 Line Blind

The new Robinson duplex line blind has been developed to incorporate a positive line shutoff with a means of accurate measurement. When used as a line blind valve, the wedge-shaped blind and full flow plate are furnished. If used as a combination orifice fitting and line blind valve, the wedge-shaped orifice plate holder with orifice plate are included and if used as an orifice fitting, the holder and plate are furnished.

An "O" ring is used to form a pressure seal joint between the wedge and the body. The elevator screw in conjunction with the adjustable lug and nut enables the operator to change the flow controlling member in a short time. This control member may be changed without spreading the line and without spilling the contents of the line.

Robinson Orifice Fitting Co.

2 Air Conditioning Unit

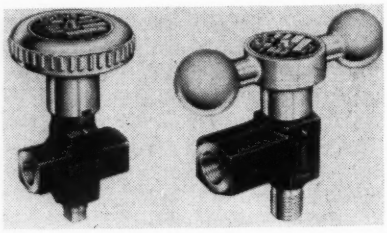


Bryant Heater's new double air conditioning units, named the "Command-Aire" twins, are designed to bring the average home owner low-cost, year-round air conditioning. The units may be installed together or separately. Installation of the heating unit may be followed at a later date by the addition of the cooling unit without the necessity of adding ducts or making other alterations.

Separate blower systems in each of the twin units assure the proper delivery of air for both heating and cooling.

Bryant Heater Div.

■



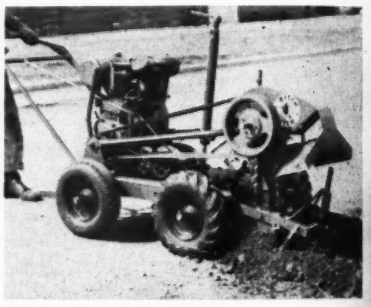
3 Valves and Gauge Cocks

The new series T-2 triport valves and gauge cocks apply the Grove "Seal-O-Ring" principle to ¼- and ½-in. valves for pressures from 3000 to 10,000 psi. Designed for meter manifolds, gauge lines, and blow-down services, the resilient "O" ring seals used in the seat assembly provide bubble-tight shutoff or flow in either direction, and on the stem, replace conventional stuffing box packing. Actuated by a handwheel, the stem slides open and closed without turning, resulting in minimum wear.

A safety stop prevents stem being forced out by excess pressures, and a safety shear ring prevents stem being backed out with the handwheel. Wiping action of the "O" ring retainer and the stem ring keeps parts free from damage by foreign matter, assuring a tight seal and free valve action. Both size valves are available for 3000, 5000 and 10,000 psi and ½-in. gauge cocks in globe or angle design for 10,000 psi.

Grove Regulator Co.

■



4 Lightweight Trencher

The Ditch-Witch Model N trencher is a light weight, heavy duty trencher used primarily for the laying of small diameter pipe. The extreme lightness (500 lbs) of the Model N makes it easy to transport in a pickup truck or two-wheel trailer.

While digging, the forward motion is provided by a ratchet wheel attached to the rear axle that may be actuated by hand or by a power eccentric, at the option of the operator. Steering is provided by removable handle bars. V-belt drives and balanced design provide flexibility.

A trench size 2 in. wide and hydraulically controlled depth from 0 to 24 in. are standard. Maximum depth to 30 in. is available on special order. Divided chute discharges spoils on both sides; spoil plows move

Mail this Coupon for **NEW PRODUCTS INFORMATION**
COPIES OF NEW LITERATURE
GAS, 198 S. Alvarado St., Los Angeles 57, Calif.

9/53 Fill in numbers of items in which you are interested.

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NAME AND TITLE.....

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Regulators

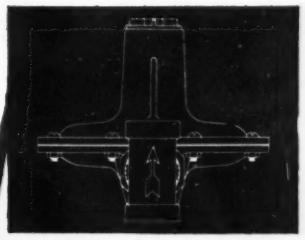
with Turn-About BODY

New design allows regulator to be installed in *ANY* position. Factory tested and assembled as you specify or can be easily changed in the field. No special wrenches required. All working parts still interchangeable. Suitable for all standard pressures and for low pressures on pressure elevation programs. Available in ¾", 1" and 1¼" Body Sizes.

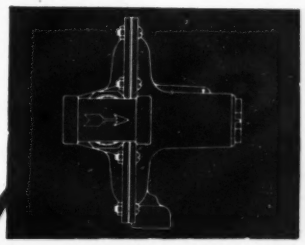
Write for new Catalog P10A.

FISHER GOVERNOR COMPANY

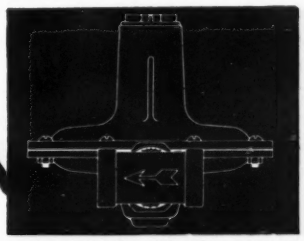
MARSHALLTOWN, IOWA



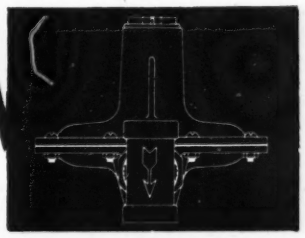
Series 730C For Standard Installation



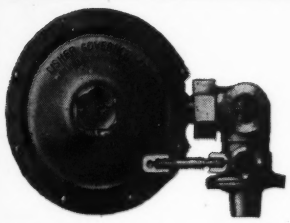
Series 730CDU For Outdoor Installation with Diaphragm Vertical and Weatherproof, Bugproof Drain Vent



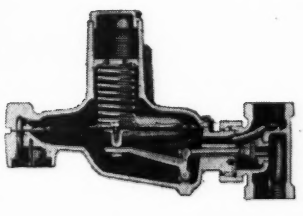
Series 730C with Flow Horizontal from Right to Left



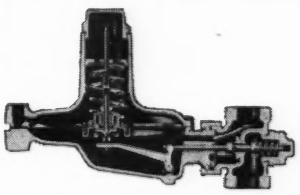
Series 730C with Flow Downward in Direction



• **Type 732CN General Service Regulator** with Full Capacity Relief Valve on Body. Sizes ¾", 1", 1¼". Spring bonnet vented to ¾" outlet of full capacity relief valve to allow use of single regulator vent line on indoor installations.

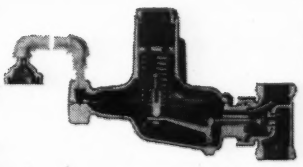


• **Type 730CU Outdoor Service Regulator.** Weatherproof vent housing integral with lower casing for outdoor locations.



• **Type 735CT General Service Regulator** with Magnetic Safety Shut-off Feature.

Shuts off the flow of gas entirely either if the downstream pressure should exceed the regulator setting by a predetermined amount, or if there is a failure or near-failure of supply pressure.



• **Type 733CT General Service Regulator** with Internal Relief Valve.

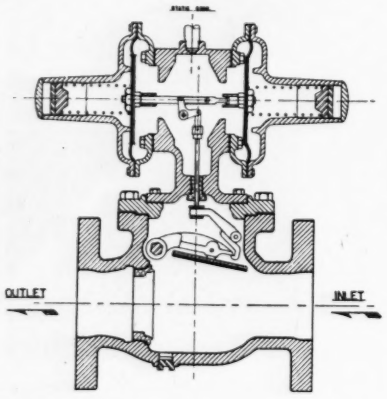
Complete with weatherproof stabilizer vent for remote venting of indoor installations.

FISHER

boiled-up material away from the edge of the trench. Follow-up scraper is detachable and its use is optional.

Charles Machine Works

■



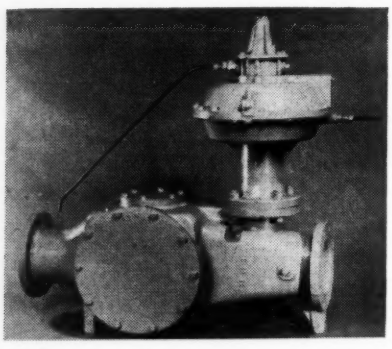
5 Shutoff Valves

Eight new and improved basic models of its automatic shutoff valves are available from Security Valve Corp. They will provide automatic shutoff on gas or fluid lines in the event of either increase or decrease in pressure. Installation may be upstream or downstream, in relation to the regulator, with or without static line control for high or low pressure application.

The through-flow design provides for installation in existing pipelines with negligible pressure drop. Model "IDPS-L," which closes on increase or decrease of pressure, with static line control in a low pressure application, is shown. Valves are available in cast iron or steel.

Security Valve Corp.

■



6 Pilot Loading System

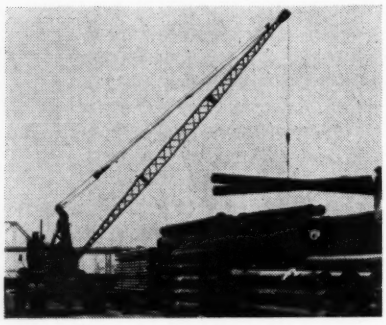
Increased safety and versatility of Rockwell's standard "014" regulators are brought about by a new "pilot loading system." As a special safety feature of the new system, the valves of the pilot-loaded 014 automatically close in case of inlet pressure failure or diaphragm case breakage. The entire mechanism is enclosed to discourage tampering.

According to the manufacturer, the greatly increased pressure range of pilot-loaded regulators extends their field of application to include many installations that formerly required a high pressure regulator.

Complete systems are available for changing over existing Rockwell 014 regulators to power pilot loading.

Rockwell Manufacturing Co.

■



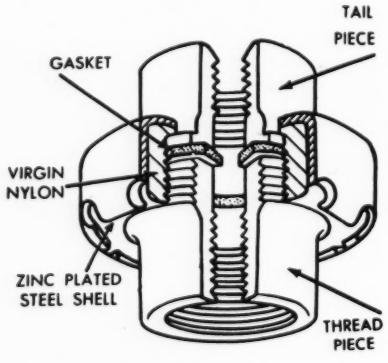
7 Truck Crane

A new highly mobile truck crane, designated as the Pitman Crane Model 80, has a capacity up to four tons on a 25-ft boom, with additional boom lengths up to 59 ft. Designed for installation on trucks 2½ tons or larger, this crane has a versatile loadline winch which can be operated either power-up and power-down or free-spooling.

Precise boom action is afforded by (1) a power-up and power-down topping winch, which raises and lowers the boom, and (2) a double-acting hydraulic cylinder which swings the boom in a 180° arc. An outstanding feature of the crane is that a fifth wheel can be installed on the crane's subframe on a long wheelbase truck, enabling the same truck to haul a trailer.

Pitman Manufacturing Co.

■

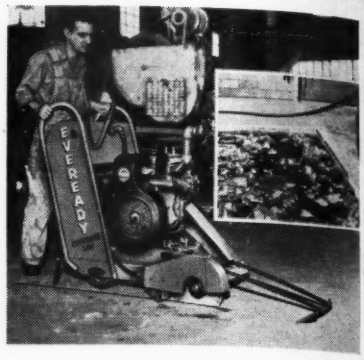


8 Unions and Meter Nuts

Reduction in electrolytic corrosion is claimed through the use of new insulating unions and meter nuts, which utilize the strength and insulating properties of molded nylon in forming a strong union between the tail piece of the meter and pipeline.

The two metal parts in the union are separated by a gas-resistant insulating gasket which serves to retain pressure. The meter nut itself is of molded DuPont nylon over which a zinc-plated steel shell is crimped as a container. An opening in the center of the nylon is machined to proper tap drill size and tapped to the proper thread size.

Universal Controls Corp.



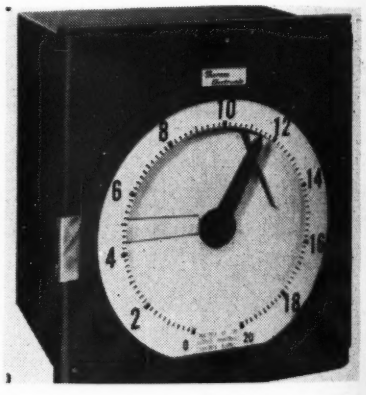
9 Concrete Saw

Savings in both time and material are promised to result from the use of the new Eveready concrete saw introduced by the Eveready BrikSaw Co., featuring hydraulic control for lowering the blade.

Besides "Hydra-Eze" blade control, the saw features include: (1) "Tri-Matic" blade alignment, an automatic floating action of the saw wheels that prevents any binding or tilting of the blade when the saw is operated over uneven surfaces; (2) a dual blade shaft that makes it possible to place the blade at either side for sawing in corners or confined areas; (3) a depth control lock that allows cutting to a predetermined depth; (4) a friction-type foot brake that holds the saw on hills or inclines; and (5) dash board controls that make possible every cutting operation by the operator from his place behind the saw.

Eveready BrikSaw Co.

■



10 Electronic Recorder

The Thermo electronic recorder is available in both potentiometer pyrometer and resistance thermometer bridge types. For temperature the recorder is made in a large number of different ranges from −100° to +3000° F. It is suitable also for recording humidity, solution conductivity, speed, pH, d.c. current or voltage, power, strain, or other types of measurements that can be converted to a change in resistance or d.c. millivoltage.

The instrument records on a 12-in. circular chart and indicates on a large circular dial with pointer clearly visible at 50 ft. The use of a cam in the recording system

permits linear charts to be used on practically all measurements despite non-linearity or thermocouple voltage or other sensitive element characteristics.

Thermo Electric Co.

■

11 Shutoff Valve

Development of a high-tensile, aluminum alloy gas shutoff valve, which tests two to three times stronger than ordinary gas shutoff valves, has been announced by Thermac Co. The new valve, which will not gall or stick, incorporates a straight-through passageway for maximum flow. A pilot gas take-off may be provided on either side of the valve to suit the appliance manufacturers' specifications.

Thermac Co.

Trade Literature

12 Inside Story of Outside Help

"The Inside Story of Outside Help" tells of how large and small enterprises throughout the United States and many foreign countries are served by Ebasco Services Inc. Described in this booklet are the engineering, construction, and business consulting services offered to public utility, industrial, financial and other enterprises.

Ebasco Services Inc.

■

13 Pavement Breaker Catalog

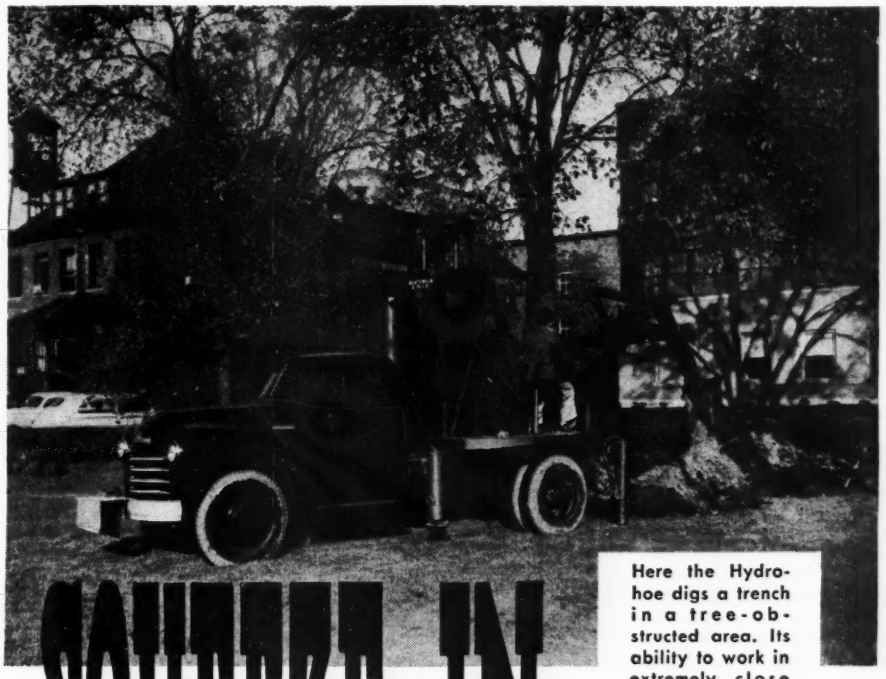
"The Right Paving Breaker for Every Job" is the theme of a new catalog issued by Ingersoll-Rand Co. This new piece of literature tells the story of Ingersoll-Rand's series of breakers from the 14-lb J-10 to the 146-lb R-30. Besides individual pictures of each machine, the catalog features a section illustrating the individual tools and accessories available for the complete line.

Ingersoll-Rand Co.

■

14 Digger Bulletin

Cleveland Trencher's improved Model 92 Baby Digger is described in a new eight-page bulletin. Detailed information on the design and construction of the 92, together with a table of digging wheel and traction speeds furnished by the new transmission are con-



Here the Hydrohoe digs a trench in a tree-obstructed area. Its ability to work in extremely close quarters often permits the Hydrohoe to handle jobs normally requiring expensive hand labor.

SQUEEZE-IN SPECIALIST

BUCYRUS ERIE HYDROHOE

For trenching, valve pit digging, and leak repair work the all-hydraulic Hydrohoe is the stand-out performer, especially when the work requires squeezing into tight places. Here's why:

1. **Hydraulic outriggers provide outstanding stability.**
2. **Extremely short tail swing permits operating in narrow alleys, on tree-lined streets or at busy intersections . . . work under almost impossible conditions.**
3. **Hydraulic ejector pushes dirt out of 12- or 18-inch dipper quickly, cleanly even without hoisting dippers to full dump position.**
4. **Telescoping boom makes it easy to duck under wires or tree branches — reach into confined spots and bring out big loads.**
5. **Can be converted to crane in amazingly short time — right in the field.**

Get proof of performance on your work. See your Hydrocrane distributor for a demonstration. 31H53

BUCYRUS-ERIE CO. SOUTH MILWAUKEE, WIS.

tained in the bulletins. Text describes component parts and special Cleveland features.

In addition to photographs of the parts of the unit and its applications, complete dimensions and specifications are given, including a table of optional digging widths.

Cleveland Trencher Co.

■

15 Compressor Booklet

Full data on Davey industrial air compressors are given in an eight-page booklet describing Davey units ranging from 10 to 100 hp sizes with displacements of 55 to 540 cfm. An interesting feature is a comprehensive table which shows the number of industrial tools of various types which can be operated by each size compressor.

Davey Compressor Co.

■

16 Gas Alarm Bulletin

Scanning type multi-point J-W combustible gas alarms for industrial protection are described in a new leaflet released by Johnson-Williams Ltd. This publication describes the features and operating principle of indicating and recording instruments in standard and explosion-proof styles.

Johnson-Williams Ltd.

WET TRENCH NO TROUBLE WITH

McWANE-PACIFIC BOLTITE MECHANICAL JOINT CAST IRON PIPE

An incidental but important advantage of Boltite Mechanical Joint is the elimination of joint-making troubles in wet trenches. There is no danger of hot lead "exploding" due to creation of steam. The Boltite joint consists simply of a thick, triangular-shaped, composition rubber gasket, compressed by a movable gland when the bolts are tightened. There is no hazard in assembling this joint in a wet trench. In fact, it can be done under water.

Boltite Mechanical Joints are bottle-tight, flexible, permit pipe-line expansion or contraction. Perfect joints are easily and quickly made by one inexperienced workman. The only tool needed is a ratchet wrench. Write or telephone for complete information.

McWANE Cast Iron Pipe Company
Birmingham, Ala.
Pipe Sizes 2" thru 12"

Sales Offices

Birmingham 2, Ala. ..... P. O. Box 2601
Chicago 1, Ill. ..... 333 North Michigan Ave.
New York 4, N. Y. ..... 80 Broad Street
Kansas City 6, Mo. ..... 1006 Grand Avenue
Dallas Texas ..... 1501 Mercantile Bk. Bldg.

PACIFIC STATES Cast Iron Pipe Co.
Provo, Utah
Pipe Sizes 2" thru 24"

Sales Offices

Provo, Utah ..... P. O. Box 18
Denver 2, Colo. ..... 1921 Blake Street
Los Angeles 48, Cal. ..... 6399 Wilshire Blvd.
San Francisco 4, Cal. ..... 235 Montgomery St.
Portland 4, Oreg. ..... 501 Portland Trust Bldg.
Salt Lake City ..... Waterworks Equip't Co.

Current Reading

TEXTBOOK OF THE MATERIALS OF ENGINEERING—Eighth Edition, Herbert F. Moore and Mark B. Moore; McGraw Hill, $6.00. The gas engineer, regardless of his particular field of activity, will find information of interest and value in this revised edition on the subject of engineering materials.

The book undertakes an elementary discussion of the properties of various materials which affect their strength, stiffness, ductility, and resistance to corrosion or wear. These properties are discussed with respect to how well they will offer resistance to structural damage by applied movements and forces. Such properties as flow, elasticity and plasticity, toughness and brittleness, malleability, and durability are defined and applied to a range of practical materials such as wood, stone, concrete, rubber, and plastics as well as the metals.

Although the book makes no effort to include a complete tabulation of the properties of the hundreds of structural metals and alloys now available, reference is made to several handbooks which do compile such values. This book is intended primarily as a text for use in courses on the materials of engineering or as a reference work for persons who deal with the materials of engineering in their daily work.

PETROLEUM IN THE WESTERN HEMISPHERE—The results of a two-year study of the Western Hemisphere petroleum resources by a committee composed of 44 experts in petroleum economics, production, geology, law, and engineering have been published in book form by the Independent Petroleum Assn. of America. A comprehensive analysis of future availability of petroleum through 1960 is provided and exhaustive reports on past, present and future trends in petroleum production, productive capacity and reserves, hemisphere supply and demand, industry materials requirements, and governmental policies and laws in oil producing countries as they affect petroleum operations are presented.

The book also establishes a formula for predicting future conditions in the petroleum industry as related to production, demand, imports, income, drilling, reserves, and productive capacity.

Additional information on the book is available from the IPAA, P.O. Box 1019, Tulsa Okla.

HANDBOOK OF ACCIDENT PREVENTION FOR BUSINESS AND INDUSTRY—The handbook, a convenient safety guide for the manager of a small business or the supervisor of a department in a large organization, shows how to set up and maintain a safety program. Detailed information is included on such subjects as plant layout, materials handling, housekeeping, machine guarding, electrical hazards, pressure vessel

hazards, first aid, fire prevention, and personal protective equipment.

For further details and prices on the 94-page handbook, write the National Safety Council, 425 N. Michigan Ave., Chicago, Ill.

GAS APPLIANCE SERVICE WATER HEATER MANUAL (4th Edition)—Prepared by the committee on gas appliance service manuals of the AGA, the new manual has been brought up to date to include the latest in controls. It includes information on the selection, installation, adjustment, and servicing of water heaters and their controls, with the text designed to eliminate unnecessary duplication between diagrams and text. The majority of the service information has been placed on the diagrams facilitating the correlation of the information with the control.

The pocket-size edition, containing 248 pages, is bound with metal ring binders to allow for insertions. Prices: $2 for single copies; $1.75, 10 to 99; $1.50, 100 or more. For further information write the AGA, 420 Lexington Ave., New York 17.

NATURAL GAS CONSTRUCTION DATA—This 50-page brochure contains specific data on more than 95% of all natural gas pipeline construction projects authorized by the FPC since July 1, 1945, excluding only projects involving less than $250,000. Included are lists of cities receiving gas during 1951-52; names and addresses of pipeline companies and operating utilities involved in pipeline construction; total natural gas construction projects authorized since 1945; summary of miles, cost, and estimated steel tonnage involved; and construction applications pending before FPC.

The booklet is available from Gas Appliance Manufacturers Assn., 60 E. 42nd St., New York 17, at $2 per copy.

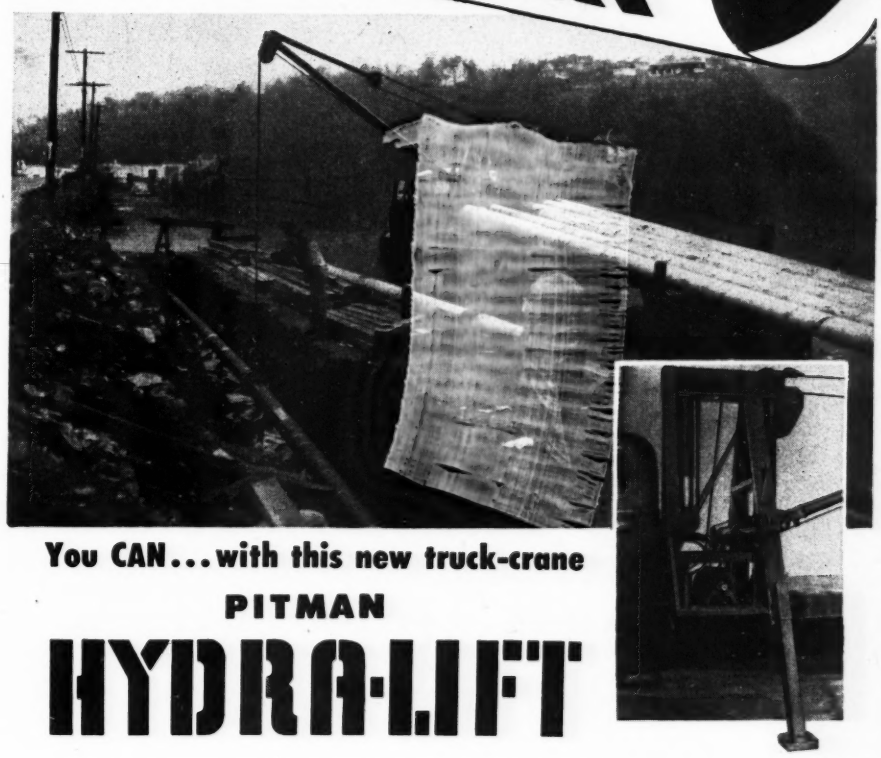
GAS FACTS—A number of tables containing new statistical material on the industry have been included in the 1952 edition. Considerable information on the use of gas and competitive fuels for cooking and househeating, new statistics on underground storage, and an index of weekly market prices, dividends and yields for the common stocks of 30 gas companies are presented.

Copies are available from the Bureau of Statistics, AGA Headquarters, 420 Lexington Ave., New York 17.

WORKING TOGETHER FOR SAFETY—This 32-page booklet contains instructions in safe work habits applicable to employees in most plants. The practical experiences of workers, supervisors and safety specialists have established the safe practices covered, beginning with a list of general safety regulations and then going into more specialized sections.

For a free sample copy and prices, write the National Safety Council, 425 N. Michigan Ave., Chicago 11.

Want to handle pipe CHEAPER?



You CAN... with this new truck-crane

PITMAN

HYDRA-LIFT

Mount a Pitman Hydra-Lift on one of your trucks and with this single piece of equipment, you can handle pipe faster and cheaper than you can with the *two or more* pieces of equipment you are now using!

How? With its swinging boom, Hydra-Lift loads pipe directly onto a trailer pulled by the same truck on which Hydra-Lift is mounted. The truck and trailer then move to the job site at normal truck speeds. At the job, Hydra-Lift is right there, ready to swing the pipe off the trailer, then lay it in the ditch. How many pieces of equipment are you tying up to do this work now?

Hydra-Lift mounts on almost any truck; two tons or larger recommended. Hydraulic power swings the boom 180°, lifts it through an arc of 100°. Boom telescopes from 12 to 17 to 22 feet. Loadline capacity up to 6400 pounds. Yet Hydra-Lift requires but 40 inches behind your truck cab. *Hundreds* of Hydra-Lifts are being used by contractors and utility companies all over the country to cut pipe handling costs!

MAIL THIS COUPON TODAY FOR FULL INFORMATION!

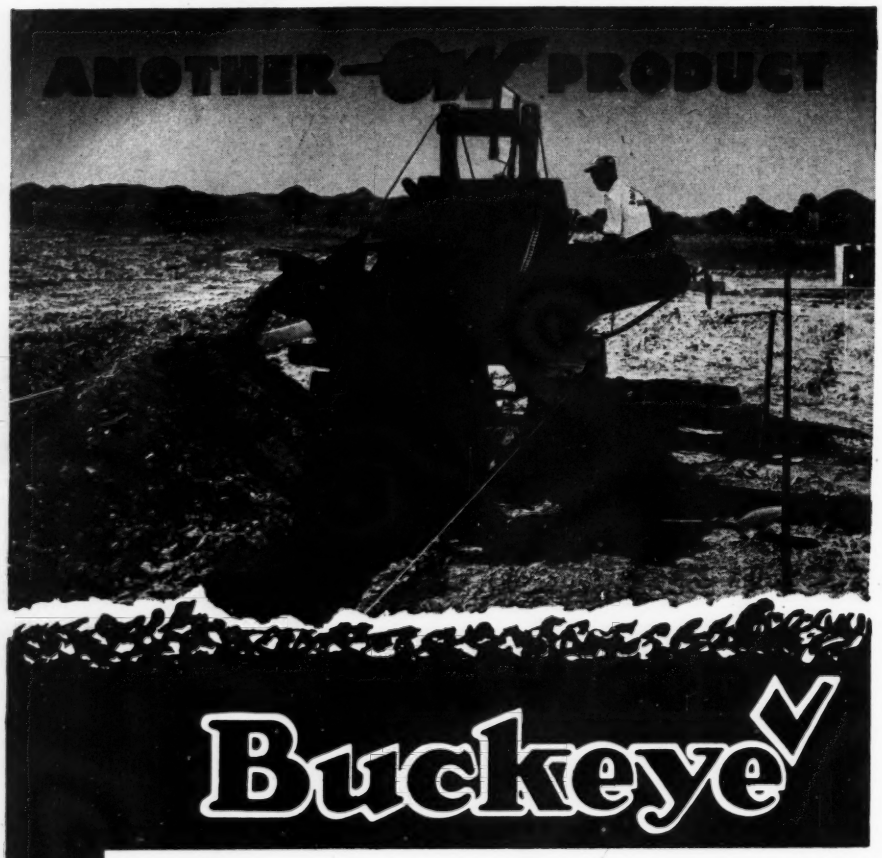
Pitman Mfg. Co.,
300 West 79th Terrace
Kansas City, Mo.

Please send me more information about the low-cost Hydra-Lift.

Name.....

Address.....

City.....State.....



Buckeye

MEDIUM UTILITY DITCHER

...for Greatest Dollar Value!

Buckeye's brand new model 303 is the outstanding wheel-type ditcher for its size and capacity developed in 60 years of Buckeye experience! . . . Low in first cost and easy to maintain it has been "contractor proven" in a wide variety of soils and climates . . . Digs to 5 ft. depths in 10, 12, 14, 16, 18 and 20 in. cutting widths at digging speeds up to 18 f.p.m. . . . Cuts the right size ditch for most applications in city, county and utility work and is ruggedly built to withstand the many abuses usually encountered . . . Small and compact with low ground bearing pressure . . . Positive depth control in hilly and rough terrain . . . Your dealer has complete details and —

Only Buckeye has a Ditcher for every Ditching Job!

GAR WOOD GW TRADE MARK INDUSTRIES

GAR WOOD INDUSTRIES, INC.

1-5310

People

Promotions

Organization changes made at the directors meeting of California-Pacific Utilities Co., San Francisco, include election of E. K. ALBERT, former vice president and chief engineer to post of executive vice president. E. E. KIME, vice president and manager of eastern Oregon division, was made a director; assistant secretary D. J. LEY was elected treasurer; and J. B. JONES was elected assistant secretary and auditor.

Lone Star Gas Co., Dallas, has promoted W. R. PAYNE to manager of the general accounting division. J. H. SAWYER, assistant chief accountant, succeeds Mr. Payne as chief accountant. Also promoted is H. J. YONKERS from chief statistician to manager of auditing and statistical division.

K. T. DAVIS has been appointed director of engineering and product development for Bryant Heater division of Affiliated Gas Equipment Co., Cleveland. He joined Bryant in 1942.

K. T. Davis
Affiliated Gas

J. T. Brown
Equitable Gas

Effective August 1, JOHN T. BROWN was elected vice president and general counsel of Equitable Gas Co., Pittsburgh.

CHARLES C. KRAUSSE has been appointed assistant general sales manager and LAWRENCE E. BIEMILLER made manager of industrial fuel for Consolidated Gas Electric Light & Power Co. of Baltimore. Appointments were effective July 1.

PAUL B. CRESSOR JR. has been promoted to manager of purchasing for the Eureka Williams Corp. He has been with the company since 1946.

BERT COLE, eastern regional manager of Servel Inc., has been named vice president and member of the board of Servel-New York Corp., distributing subsidiary in the New York area.

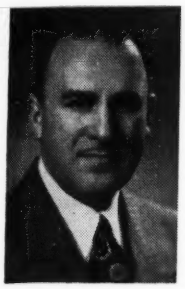
ALBERT V. SCHWARTZ has been elected assistant treasurer of the Columbia Gas System Service Corp., New York. He has been assistant controller of the corporation in Columbus.

FRED A. RIVES of Atlanta has been elected executive vice president of Consolidated Gas Co.

Peoples Water & Gas Co., Miami, has appointed TOM MARTIN as district manager in North Miami and TED RHEAUME as assistant division manager in Broward county.

SAMUEL A. HORSFIELD has been elected assistant vice president in charge of gas operations and WILMOT O. SMITH, assistant vice president in charge of electric operations for the Long Island (N. Y.) Lighting Co. Mr. Horsfield was gas operating manager and Mr. Smith was electric operating manager.

BERNARD H. WITTMAN, 33-year veteran of the sales division, has been appointed assistant to the vice president in charge of sales for the Peoples Gas Light & Coke Co., Chicago. Succeeding him as manager of the domestic sales department is ROY B. MUNROE, south section sales director for the past 17 years. Another 17-year man, south section district sales supervisor ROBERT E. SPANGLER, moves up to the section director post.



R. B. Munroe **B. H. Wittman**
Peoples Gas Light

Philco International Corp., Philadelphia, has announced the promotion of W. H. JEFFERY to vice president and general manager of the Philco Corp. of Canada Ltd., Toronto. He has been with the corporation since 1945.

Executive personnel changes made recently by United Gas Improvement Co., Philadelphia, include MARTIN H. PARKINSON, former vice president and comptroller, elected executive vice president; EDWARD H. SMOKER, elected vice president to succeed FRED B. HOFFT, who retired; and ROBERT S. WILLIAMS, appointed comptroller to succeed Mr. Parkinson.

Stockholders of South Atlantic Gas Co., Savannah, last month created two new posts and elected four new directors to its board. Filling the new posts are president HANSELL HILLYER as chairman of the board, and vice president CLIFFORD J. NODA as vice chairman. New directors are J. E. CAY JR., president of Palmer & Cay Inc.; CARL ESPY, president of Espy Paving & Construction Co.; WALTON K. NUSSBAUM and WIL-

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FAST, SAFE, ECONOMICAL

ARE YOU GETTING ALL THESE ADVANTAGES NOW

- Coating material of plasticized coal tar enamel or filled asphalt enamel.
- Reinforcement of woven glass textile fabric.
- Strip separator sheet to prevent sticking in rolls regardless of temperatures.
- Excellent bond to adjacent coating and pipe.
- Conveniently applied to full 3/32 inch thickness.
- No waste of bituminous material.

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PROTECTO WRAP CO.
ENGLEWOOD, COLORADO

LIAM R. GIGNILILAT, both vice presidents of South Atlantic. Mr. Gignililat has just rejoined the company, returning from Houston after five years with the Fish Engineering Co. and Transcontinental Gas Pipeline Corp. He is still an officer of Transco.

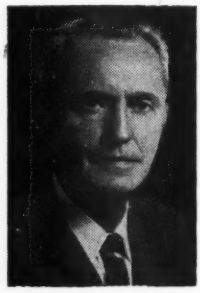
Recent changes in management of Permaglas-Heating division, A. O. Smith Corp., Kankakee, Ill., include the appointment of KENNETH E. LOFGREN as sales promotion manager, in addition to his duties as division advertising manager; GEORGE P. HOUGH, Chicago, an assistant to the president, has been assigned the additional duty of chairman of the operation committee; and former eastern district sales manager

W. W. Stake

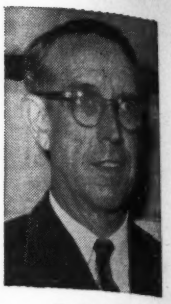
G. P. Hough

A. O. Smith Corp.

WALTER W. STAKE has been named assistant general sales manager with office in New York.



C. A. Renz



G. G. Dye

Southern California Gas

C. A. RENZ has been appointed to fill the new position of manager of special services for Southern California Gas Co. Succeeding him as manager of customer service is J. N. SHRADER, formerly northern division manager in Glendale. GORDON G. DYE, supervising distribution engineer, will assume Mr. Shrader's vacated post.

Oklahoma Natural Gas Co. has appointed JAMES R. SHIPMAN as Tulsa district heating and air conditioning engineer. He succeeds V. W. MILES who has been transferred to Enid, Okla., as sales manager of that district.

EDWARD D. FLAVIN has been appointed manager of the newly formed Public Utilities section of Johns-Manville Corp., New York. He joined the company in 1929 as a salesman.

The Geo. D. Roper Corp. has made the following management promotions: vice president and treasurer JOHN H. MAKEMSON to vice president and general manager, appliance division; assistant treasurer and controller C. R. OEHLER to treasurer; works manager and vice president, ordnance division, L. R. JENSEN to operations vice president; F. R. DICKERSON, vice president and general manager, pump division; vice president, appliance sales, E. C. SORBY to vice president, trade and public relations; assistant works manager, appliance and ordnance divisions, H. D. WEIGEL to general manager, ordnance; assistant controller C. A. MILLER to controller; assistant secretary W. F. HINZ to assistant treasurer.

MARK L. SHEPARD has been appointed manager of the Richmond division of Gar Wood Industries Inc., Richmond, Calif. He succeeds J. B. STEED, who will report to the company's Wayne, Mich. office as director of sales and manufacturing.

Leeds & Northrup Co., Philadelphia, has elected I. MELVILLE STEIN as president to succeed CHARLES S. REDDING, who has become chairman of the board. Secretary-treasurer D. H. SCHULTZ was elected executive vice president, succeeding Mr. Stein and retaining duties as treasurer. Vice president GEORGE W. TALL JR. assumes the additional duties of secretary.

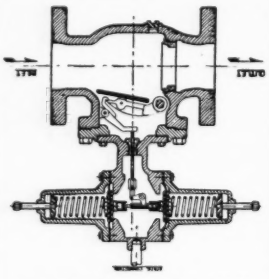
JOSEPH M. LOW, editor of *The Beacon*, Hope Natural Gas Co.'s employee magazine,

THERE IS A *Security* AUTOMATIC

SHUT-OFF VALVE FOR EVERY REQUIREMENT

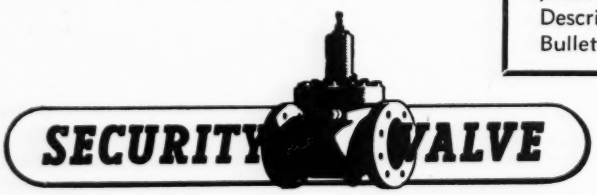
Security Valves will provide automatic shut-off in the event of either increase or decrease in pressure. Installation may be upstream or downstream (in relation to the regulator), with or without static line control, for either high or low pressure application.

Write for New Comprehensive Bulletin



MODEL "IDPS-H"

(closes on Increase OR Decrease in Pressure; Static line control, High pressure application). Described in detail in Bulletin 227-C.



SECURITY VALVE CORPORATION

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AUTOMATIC INCINOR

GAS-FIRED INCINERATOR

A "MUST" in Homes with Automatic Heat

A FULL-PROFIT LINE • NO TRADE-INS

INCINOR IS APPROVED BY A.G.A. LABORATORIES

ACT NOW FOR COMPLETE DETAILS

INCINERATION DIVISION, BOWSER, INC., CAIRO, ILL.

retired August 1 after nearly 35 years with the Clarksburg, W. Va. company.

CHARLES H. HABFAST, superintendent of distribution, gas department, Burlington district, has retired after 46 years with Public Service Co., Newark, N. J.

New faces

New sales manager for Titan Valve & Manufacturing Co., Cleveland, is DONALD J. WOOD. He comes to Titan from Duval Engine Co. where he held a similar post.

Rom Rhome
Carlon Products

D. J. Wood
Titan Valve

Carlon Products Corp., Cleveland, has announced the appointment of ROM RHOME as manager of sales, southwestern region, including Texas, Louisiana, Arkansas and Oklahoma. He was formerly with the Consolidated Western division of United States Steel Corp.

RICHARD P. MURLLESS, Phoenix, has joined Rockwell Manufacturing Co.'s meter and valve division as sales engineer for Arizona.

Transfers

H. M. MCDANIEL has joined the sales staff of Republic Steel Corp., Cleveland. He will supervise the sale of plastic pipe and tubing. He comes to Republic from Tennessee Eastman Co.

DONALD A. HAMILTON has left his post as treasurer-director for Republic Light, Heat & Power Co. and treasurer of Dominion Natural Gas Co. Ltd. to assume duties of budget director for the newly formed Arkansas Fuel Oil Corp., Shreveport.

KIMBEL W. POFAHL, Minneapolis, has been named general manager of the Gainesville Gas Co., replacing CHARLES O. CLARK who has resigned. Mr. Pofahl comes to the company from Minneapolis Gas Co.

Deaths

THEODORE B. J. MERKT, Brooklyn, died Aug. 5 after an illness of several months. He had been an employee of Brooklyn Union Gas Co. for more than 30 years, most recently in the capacity of Kings county district manager.

CHARLES E. BRAMBLE, 61, died July 15. He had been vice president and treasurer of the California-Pacific Utilities Co., San Francisco, since 1941. Previously he had been an officer of subsidiaries of the National Electric Power Co., New York, and of the Ohio and Indiana subsidiaries of the United Public Utilities Corp.

GAYLORD B. BUCK, vice president and general commercial manager of the Public Service Co. of Colorado since 1943, died last month in Denver. He was a pioneer in the utilities industry in Colorado, beginning in 1909. He joined PSC as sales manager in 1924, became general commercial manager in 1929 and was elected to the board of directors in 1932. In 1937 he was made a vice president.

FREDERICK R. SMART, former general manager of the York (Pa.) Gas Co. and a founder of the J. C. Budding Co. of Lancaster and Harrisburg, died August 2 in Baltimore, where he had lived since 1921. He was a graduate of Stevens Institute of Technology.

N. J. HOOPER, who retired in 1951 as vice president and director of Sharples Chemicals Inc., Philadelphia, died July 19. He had served the company in various capacities for 25 years. Mr. Hooper had been special assistant to the president of Temple University, Philadelphia, since his retirement..

ARCCO
NEW
ARCCO-ANUBIS
Laboratory
GAS
BALANCE
SMALL SAMPLE—WIDE SPECIFIC GRAVITY RANGE
No manometer, vacuum pump, air drier or other complex accessories required
This instrument is identical in principle to the well known ARCCO-ANUBIS recording type dry air gas gravitometer. For laboratory use only, this beautiful instrument is ideal for testing samples brought in from the field. Unusually small gas sample is required.
Handles specific gravity range from .5 to 1.5 and by the use of weights a total range from .0 to 2.5.
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Gas Gravity Instruments
SEND FOR BULLETIN No. 101R

NEWS

West Virginia turns down gas restriction request

Four Columbia Gas System subsidiaries have been denied authority by the public service commission in West Virginia to restrict and limit the sale of natural gas for other than base load uses to new applicants for service in the state. Also cancelled was temporary authority the commission had given the utilities on March 30 and May 29 to withhold approval of applications for conversion from other fuels to natural gas.

The companies—United Fuel Gas, Amere Gas Utilities, Manufacturers Light & Heat, and Cumberland & Allegheny Gas—sought authority to limit to new applicants the sale of natural gas for other than such base load uses as cooking, water heating, refrigeration, clothes drying and other small household functions. The PSC order declared that evidence showed that there is no gas shortage in West Virginia and that it does not anticipate one this winter.

In New York, the Iroquois Gas Corp. was notified that the public service commission had granted it authorization to connect 10,000 additional househeating installations. Stuart H. Nichols, Iroquois vice president, said the new installations will be connected before the fall heating season begins.

Ultimate customers bought 3788 million therms in June

A gain of 12.6% over sales of the gas utility industry to ultimate customers during June was shown when sales totaled 3788 million therms, compared to 3363 million in the same month a year ago. The AGA's June index of total gas utility sales is 164.4% of the 1947-1949 average.

In the 12-month period ended June 30, utility gas sales totaled 54,800 million therms, an increase of 9.4% over 50,073 million sold in the previous cumulative period.

Utility sales in June totaled 3561 million therms, up 13.7% over the June 1952 figure. For the 12 months ended June 30, natural gas sales amounted to 51,552 million therms, a gain of 10.5% over sales of 46,646 million in the previous 12-month period.

Manufactured and mixed gas sales in June totaled 227 million therms, a decline of 2.4% under a year earlier. The 12-month figure was down 4.9%.

Wilbur Jackson, assistant vice president of Robertshaw-Grayson, frames the one millionth Model B Unitrol junior thermostat produced by that company.

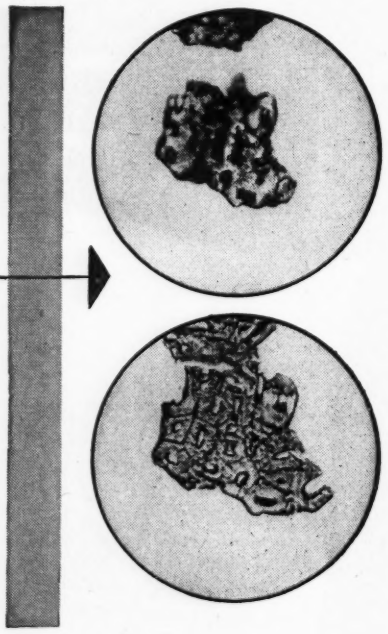
West Coast expansion plans made by Robertshaw-Fulton

Robertshaw-Fulton Controls Co. has acquired a 30-acre site in the Long Beach, Calif., area for construcion of a $2.5 million plant to house the company's Grayson Controls Div., now located in Lynwood, Calif.

Part of an extensive expansion program, the new facilities will consist of a 212,000-sq ft building. Tentative completion date is June 1954. The company proposes to employ 2000 to 2300 people in the plant and distribute an annual payroll of some $7 million. At the present time, Grayson, which has grown from a two-man operation to a business employing more than 1000 people, is celebrating its Silver Jubilee.

Robertshaw has also announced the open-

PROOF!



1. CARBOSEAL ANTI-LEAK Trade-Mark

stops leakage due to dried-out fiber packing in bell-and-spigot joints.

PROOF: The dry jute fiber (magnified cross-section, top) swells as much as 44% when it's treated with CARBOSEAL anti-leak (bottom). In a joint all the fibers swell, openings between them close up, and leakage stops.

2. CARBOSEAL anti-leak gives lasting results.

PROOF: Distributors of dry gas have used enough CARBOSEAL anti-leak to treat 13,000 miles of 3-inch equivalent main. And the first joints treated with CARBOSEAL anti-leak—20 years ago—are still tight.

3. CARBOSEAL anti-leak is inexpensive.

PROOF: Cost of CARBOSEAL anti-leak to treat 1 mile of 3-inch equivalent main is about $100.

4. CARBOSEAL anti-leak is easy and economical to apply.

PROOF: Prove this for yourself. Write for a copy of our booklet, Form 4506 — also, our 16 mm. color-sound movie, "CARBOSEAL Anti-Leak," which we will lend you without charge.

CARBOSEAL ANTI-LEAK

Carbide and Carbon Chemicals Company
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.
In Canada:
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A complete line of Robertshaw-Grayson controls for every water heater

Finer Looking, Finer Performing

UNITROL®
Model A

The "Cadillac" of Water Heater Controls. The 100% control that has everything.

UNITROL® Jr.
Model 100

A completely new, large capacity, 100% shut-off type thermostat suitable for all gases, incorporating an accurate thermostatic control, a combination pilot and main gas valve, a magnet assembly of new and improved design, and an integrally installed pilot gas filter replaceable without breaking control connections.

For High Quality Performance... at Low Cost

UNITROL® Jr.
Model B

Combines an accurate thermostatic control, a sensitive and positive thermo-electric automatic pilot and a greatly improved "A" & "B" gas valve in a single unit, high quality, competitive water heater control.

Robertshaw-Fulton
CONTROLS COMPANY
Greensburg, Pennsylvania

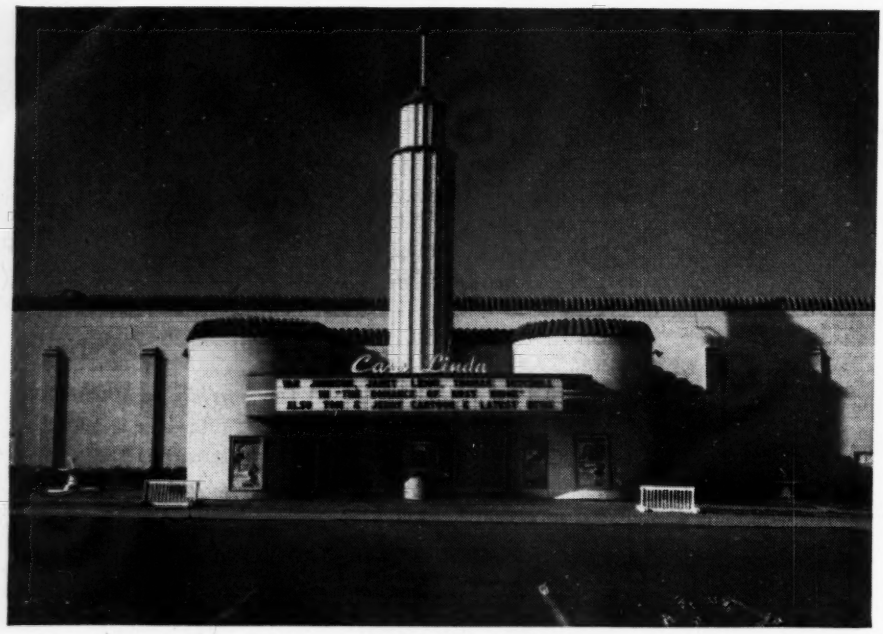
ROBERTSHAW THERMOSTAT DIVISION
Youngwood, Pennsylvania

GRAYSON CONTROLS DIVISION
Lynwood, California

You can count on Robertshaw-Grayson for top quality controls and top quality field performance.

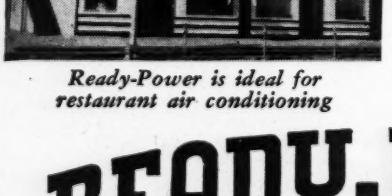
Build Profits

with LOW COST AIR CONDITIONING



Ready-Power Air Conditioning with Natural Gas pays off for this user

More and more super markets are using Ready-Power



Ready-Power is ideal for restaurant air conditioning

"... The total natural gas consumed July through October was 224,300 cu. ft. at 50c per M, or a total cost of $112.15. Should we have used electric power, we figured that the electric costs would have been $680.53 for this same period. Considering that the Ready-Power units operated just about one-half of our normal air conditioning season I think that we are safe in assuming that we can expect to save about $1,100 a year."

Very truly yours,
TRI-STATE THEATERS
J. R. Euler, Dallas, Texas

You too can have air conditioning at far less operating cost by installing Ready-Power equipment. Ready-Power natural gas air conditioning units operate at the *lowest cost known*. Why not take advantage of this inexpensive method of air-conditioning. Write The Ready-Power Company for complete information.

READY-POWER

SAVES AS IT SERVES

THE READY-POWER CO. • 11231 Freud Ave., Detroit 14, Mich.

Manufacturers of Gas and Diesel Engine Driven Generators and Air Conditioning Units; Gas and Diesel Electric Power Units for Industrial Trucks.

ing of a new combination sales office and machine shop in Cleveland for the assistance of appliance manufacturers. The sales office will handle sales matters for the Cleveland district and the machine shop facilities will be available to manufacturers who require such facilities while their appliances are being tested or altered for test at the AGA Cleveland Laboratories.

Art Concrete Works becomes Brooks Products

A firm which has served the gas industry for 43 years with pre-cast concrete meter and valve boxes will continue operations under the same owners and management but with a new name, according to an announcement by Art Concrete Works, Pasadena.

The new name: Brooks Products Inc.

H. L. Brooks

F. M. Brooks

The changing nature of the business dictated the change, according to President Frank M. Brooks. From its original role as a manufacturer of concrete art specialties and ornamental products, the company has swung its production emphasis more and more toward meter and valve boxes of pre-cast concrete until now this phase constitutes the bulk of its activity.

During the more than four decades of its existence, the firm has established branch plants in eight western, southwestern, and southern cities in order to serve customers more efficiently. Each of these branch plants will change its name to Brooks Products.

Harry L. Brooks is vice president in charge of sales for the company.

AGA lab work reveals tremendous expansion

The greatest upsurge in the gas industry's history is represented by the record-breaking numbers of new gas appliances being put through their exhaustive performance tests at the AGA Laboratories, Edwin L. Hall, lab director, reports.

The total number of new models tested at both Cleveland and Los Angeles in the first half of this year has already surpassed the numbers tested for corresponding periods in 1952 and 1951.

Appliance testing schedules are booked for months to come with no easing of test-

ing demands in sight. Current operations are 100% above the levels of the last two years and 25% above the previous peak of 1950. Among the several types of equipment submitted for approval, the sharpest rise in new models is in the field of central heating equipment, representing 55% of the appliances undergoing tests. More than 340 gas heating manufacturers list models that meet lab approval.

Twenty-four manufacturers of wall furnaces have entered the field in the last five years, laboratory figures reveal. While in 1950 only four gas clothes dryers were listed by the laboratories, 43 manufacturers are now either in production or in the planning stage. Approximately 50 manufacturers are developing gas incinerators, a third of them already having models on the market.

Six-month figures reveal greater appliance shipments

During the first six months of 1953, shipments of gas-burning appliances—water heaters, ranges, and househeating equipment—were up over the 1952 figures. GAMA statistics show that domestic ranges were up 10.2%; water heaters, 26.5%; gas-fired furnaces, 28.9%; boilers, 2%.

Figures available for the first five months of 1953 show that 671,700 electric ranges were shipped compared to 975,300 gas ranges. Second-quarter figures for range shipments approximated 581,300 units, 11.6% greater than the second quarter of last year. June shipments are estimated at 169,300.

In June, 178,300 water heaters were shipped, bringing the six-month total to 1,158,300.

Gas-fired furnaces shipped during June totaled 46,200, raising the total for the first six months to 219,300. Gas-fired boiler shipments also increased for both June and the first half of 1953: 6100 boilers went out in June, raising the total to 25,800 for the year. Conversion burners, which fell below 1952 during the first three months, picked up strongly during the second quarter to come within 0.2% of last year's first half shipments.

Republic Steel buys plastic pipe company

Republic Steel Corp., Cleveland, has purchased Owings-Sharpe Inc., a plastic pipe and tubing company located in Magnolia, Ark., to supplement its line of steel pipe and tubing and to supply its customers with a product that is coming into wide use. This step marks the first entrance of the steel company into the plastic tubing field.

Simultaneously with the announcement of the purchase, Republic appointed Jay W. Owings, organizer of the plastic tubing company, to the post of manager of sales, pipe

CALL ON THE "Specialists" FOR ACCURATE METERING

1,000,000 cfh—One R-C Positive Displacement Meter to measure large volumes saves foundation costs and possible loss of production space.
4,000 cfh—especially valuable for metering purchased or sold gas, or for proportioning and departmental cost accounting.

The successful performance of Roots-Connersville Positive Displacement Meters has long been proved by large and small industrial plants and public utilities. These users rate them high in such basic essentials as:

Accuracy—not affected by pressure, wide ranges in loads or other variables. Absence of valves, vanes and other small parts insures "cash register" accuracy over years of use.

Capacity—from 4,000 cfh to 1,000,000 cfh in one unit, with ample ability to absorb overloads.

Compactness—smallest made for industrial use in foot-for-foot of capacity. Can be located in otherwise unusable space, thus saving production areas.

Almost a century of experience in handling gas and air, exclusively, goes into the design and construction of R-C Meters. They're part of the comprehensive line of blowers, exhausters, gas and vacuum pumps and related equipment, which are the products of R-C Specialists, and which are in widest use in industry.

ROOTS-CONNERSVILLE
Exclusive Specialists in Handling Gas and Air

A new bulletin, M-152, gives complete data on R-C Meters, including a handy selection table which simplifies your choice of the right meter to suit your specific application. Your copy will be sent on request.

ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC.
534 Oregon Ave. • Connersville, Indiana

division. He succeeds Manley B. Brown, who has resigned.

Production begins in new Honeywell California plant

Limited production is now under way at the first unit of the new $2 million plant of the appliance controls division of the Minneapolis-Honeywell Regulator Co. in Gardena, Calif. Construction continues on other sections of the structure.

The factory, the first plant built by Honeywell west of Minneapolis, will produce controls for water heaters, floor furnaces, wall heaters, and central heating plants.

Honeywell's new southern California plant, where limited production is underway, occupies a 16-acre site in Gardena.

The new plant is of steel-frame, reinforced concrete construction. Two large parking lots will be provided on the 16-acre site for clients and the 2000 workers expected to be employed when the plant is completed.

Rockwell produces film on gas meter production

What is believed to be the first movie portraying the design, assembly, and operation of a diaphragm type domestic gas meter has been issued by Rockwell Manufacturing Co., Pittsburgh. An outstanding feature of "Operation 150," a half-hour 16 mm sound and color film, is an animation sequence showing exactly how a typical diaphragm meter—the Rockwell 150—accomplishes the measurement of gas.

The film starts with a brief dramatized sequence on the role gas plays in the home of today and the reasons for metering, then moves into a detailed account of the production of meter diaphragms and body castings. Also shown is the selection of the leather components and the assembly of the finished diaphragm. Detailed pictures of the manufacture of valve plates, spuds, bearings and other metal parts of the meter follow.

Tests, such as vacuum and low-light which proves the meter will register even a minute amount of gas, are also pictured. Views of sealing, painting, and shipping of the tested meter are included.

Arkansas Louisiana names public relations counsel

Reorganization of the public relations and advertising functions of Arkansas Louisiana Gas Co. has resulted in the appointment of Robert K. Butcher & Associates, Shreveport, La., public relations firm, as its public relations and advertising counsel. Several weeks ago, Arkansas Louisiana was formally separated from Arkansas Natural Gas Corp.

Robert K. Butcher will direct public relations for the gas company, coordinating the company's public relations and advertising

Sensational New Lancaster S-7

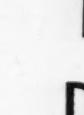
GROOVE TYPE* METAL RIM DIAPHRAGM

Smoother meter performance . . . greater measuring accuracy . . . longer service periods . . . 95% to 100% O.K. meters . . . are now possible with this improved Lancaster *groove type* metal rim diaphragm.

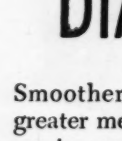
Perfectly centered in its inward and outward travel . . . perfectly balanced with surprisingly low differential . . . wonderfully smooth, consistent performance are important advantages of this new Lancaster S-7 diaphragm for small meter repairs and replacements.

Write for literature and prices today.

New Groove Type Metal Rim for greater rigidity and a perfect circle.

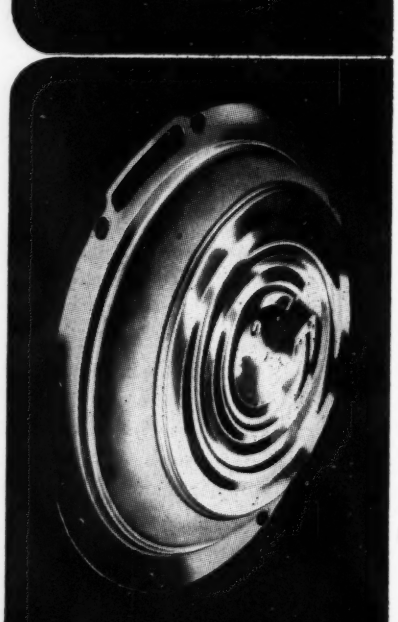


New Patented Endless Metal Tie Band for stronger clamping, more uniform depth of pocket.



New Improved Quality Rechrome Leather specially processed to Lancaster's own specifications.

*PATENT. PENDING



METER PARTS CO.

functions. Rex H. Maus, former member of the advertising department of the Arkansas Natural companies, has been appointed assistant advertising manager and editor of company publications.

Fifth Round-Up backed by $100,000 advertising fund

More than $100,000 of national advertising by the AGA will back up the fifth annual Old Stove Round-Up which will run from September through November, encouraging housewives around the country to trade in their old stoves for allowances toward the purchase of modern automatic gas ranges. Last year, despite a falling market, the Round-Up moved 250,000 models beyond the number usually sold each autumn.

Ad campaigns scheduled include four-color single and double page national advertisements set up for national publications having a combined circulation of 14 million. Concurrently, GAMA will assist in the PAR-backed activity on various fronts. In conjunction with the National Assn. of Home Builders, GAMA promotions are tying in the Round-Up with National Home Week from Sept. 20-27.

A new dimension—sound—has been added, with six spot radio commercials, presenting professionally recorded cowboy music available on a single 16-in. record.

Merger completed by two Vermont companies

Following the completion of plans originally announced in February, the merger of Public Electric Light Co. of St. Albans, Vt., into Central Vermont Public Service Corp., Rutland, became effective in July. The merger was approved by the Vermont Public Service Commission in June and by the FPC on July 7.

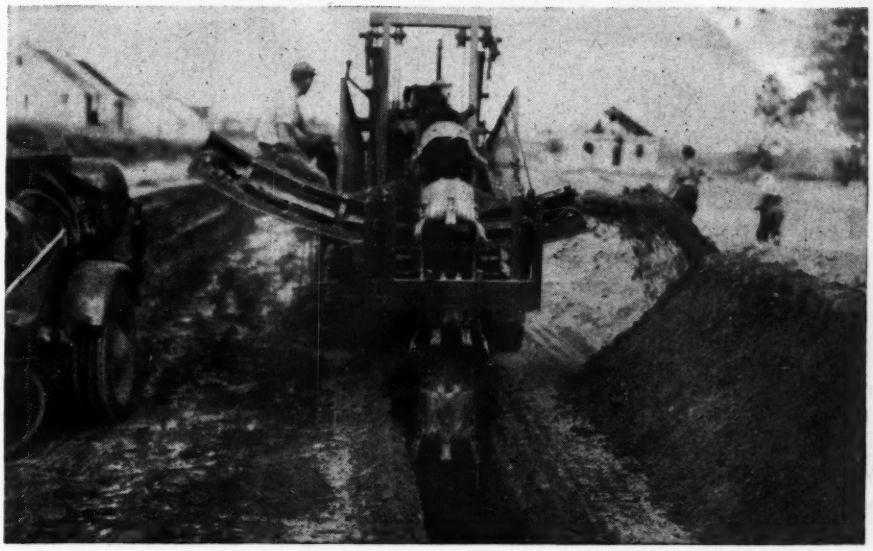
Albert A. Cree, president of Central Vermont, said that A. W. Peterson, who was president of the St. Albans company, has been elected a vice president of Central Vermont and has been named manager of the company's properties and business in the former Public Electric Light territory.

C of C appoints committee on natural resources

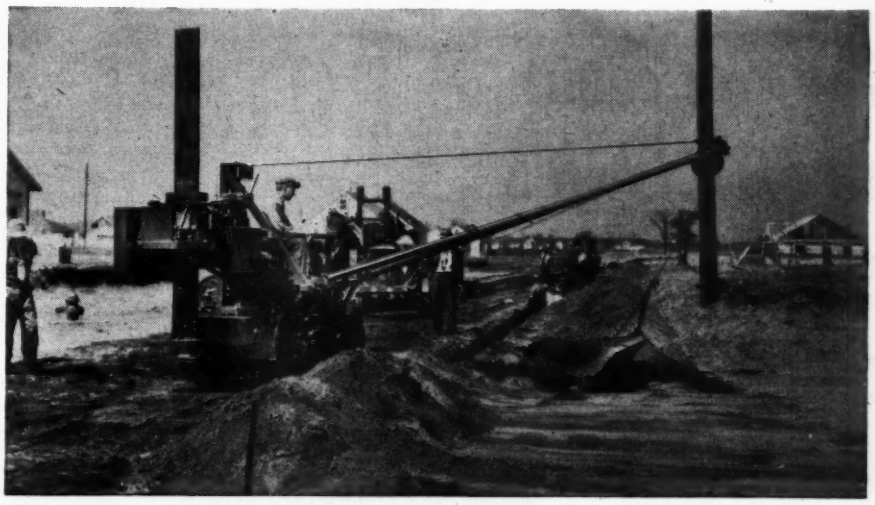
The U. S. Chamber of Commerce committee on natural resources, which is composed of 42 members representing all types of natural resource industries and related fields of energy supply, conservation, and land utilization, has been appointed for 1953-54. Members of the committee have been placed on seven subcommittees assigned to work on special projects and objectives of the chamber during the year.

Gasmen serving in the oil and gas group are W. M. Jeffords Jr., president of Brook-

Dig 'em and fill 'em with CLEVELANDS



The Cleveland "Baby Digger" Model 95 is making short work of cutting trench for a gas main extension under good digging conditions in Minneapolis. Even greater savings were effected by the 95 during severe winter digging conditions.



Here, a Cleveland Model 80 is speedily and cleanly backfilling the trench shown in the top picture. The 80 is also an excellent pipe layer. When job conditions require backfill compaction, the 80 does an outstanding job with no additional men or equipment necessary.

The CLEVELAND TRENCHER CO.
Pioneer of the Modern Trencher
20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO

The new Corpus Christi, Texas, warehouse of Grove Regulator Co., will serve Grove equipment users throughout southeastern Texas and surrounding areas.

lyn (N. Y.) Borough Gas Co.; C. P. Rather, president of Southern Natural Gas Co., Birmingham; and C. I. Weaver, director of the Ohio Fuel Gas Co., Springfield.

New A-P Control labs in operation in Milwaukee

Experimental tests on hundreds of automatic control devices are being conducted in the recently completed engineering laboratories of the A-P Controls Corp. in Milwaukee. The new, modern structure, part of a program of greatly expanded engineering and research facilities at the company's main plant, houses most of the firm's engineering activities and includes offices, design and drafting rooms, laboratories, conference rooms and an experimental machine shop.

The new engineering laboratories provide for more test rooms with automatically controlled temperature and humidity conditions. Nothing is left to chance in the research and testing program at A-P. When the firm has a control which requires testing to suit a specific appliance, A-P gets an actual manufacturer's model of the appliance to use in its laboratory, and conducts extensive performance tests under actual operating conditions.

Features in the new facilities include exceptionally fine lighting and year-round air conditioning.

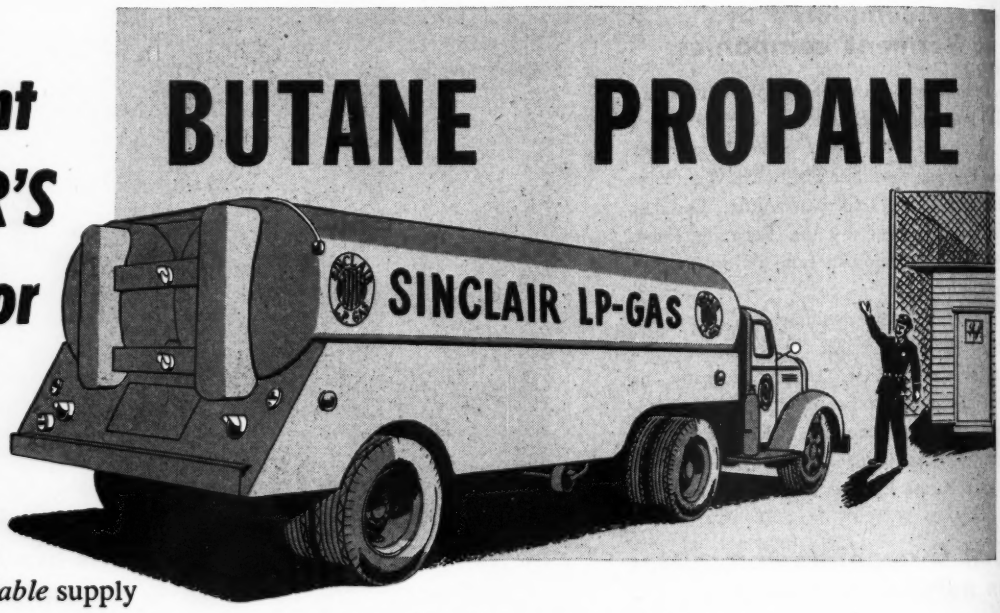
ASA publishes standards for cast iron pipe

Nine American Standards for improving cast iron pipe were published last month to provide uniformity in methods of determining the thickness and length of cast iron pipe, depending upon the pipe's diameter and the pressure it must withstand. These specifications, dealing with both spun pipe and cast or molded pipe, also include data on reasons for failure of cast iron pipe and methods for preventing corrosion.

The standards were developed under ASA Committee A21, made up of 35 producers, users and other groups interested in standardization of cast iron pipe. Administrative leadership of the project was furnished by the AGA, the American Society for Testing Materials, American Water Works Assn., and the New England Water Works Assn.

The standards include Cast Iron Pit Cast Pipe for Water or Other Liquids; Cast Iron Pit Cast Pipe for Gas; Cement Mortar Lin-

you can count on SINCLAIR'S reputation for reliability



Sinclair's reputation as a supplier in the industry is your assurance of a *dependable* supply of a *uniform, high quality* LP-Gas. Moreover, you can confidently recommend Sinclair to industrial users who require standby Butane and Propane facilities.

Sinclair has a force of trained engineers—men who are thoroughly familiar with industrial and standby utility problems. Their experience is ready to serve you. Contact Sinclair today.

SINCLAIR OIL & GAS COMPANY
NATURAL GASOLINE AND LIQUIFIED PETROLEUM GAS SALES DIVISION
TULSA, OKLAHOMA

SINCLAIR
A Great Name in Oil

ing for Cast Iron Pipe and Fittings; Cast Iron Pipe Centrifugally Cast in Metal Molds for Water or Other Liquids; Cast Iron Pipe Centrifugally Cast in Metal Molds for Gas; Cast Iron Pipe Centrifugally Cast in Sand-Lined Molds for Water or Other Liquids; Cast Iron Centrifugally Cast in Sand-Lined Molds for Gas; Short Body Cast Iron Fittings (3 in. to 12 in. for 250 psi) Water Pressure Plus Water Hammer; and A Mechanical Joint for Cast Iron Pressure Pipe and Fittings.

Gas company stock prices continue to decline

Continuing to reflect the uncertainty of general market conditions during July, natural gas company common stock price indexes showed a decline for the third successive month. The AGA index shows that stock price for 30 natural gas companies was 7.5% lower on July 31 than on a comparable day a year ago. Natural gas transmission stock prices declined 9.9%, while the price of distributing company issues increased slightly.

The price declines occurring in the composite and transmission categories, together with advances in dividend payments during the year, resulted in marked increases in the yields of these stocks, while a lesser advance occurred in yields available on the 10 gas distribution company common stocks. The yield on the 30 natural gas common stocks is now 5.47%.

Operating revenues up 28.7% during May

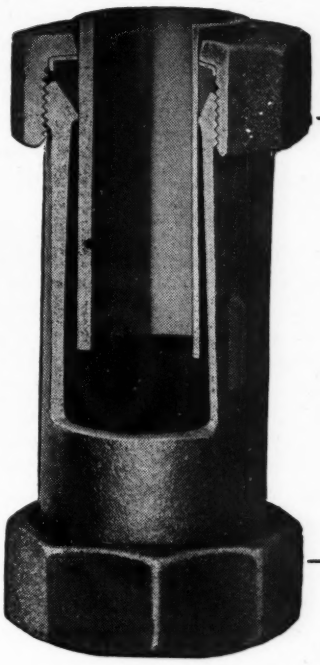
Operating revenues of natural gas companies reporting to FPC in May totaled $181,050,495, an increase of 28.7% over May 1952 receipts of $140,714,030. For the 12-month period ended May 31, revenues aggregated $2,130,328,163, up 20.2% over the $1,772,571,381 for the similar period last year.

Sales to residential, commercial, and industrial consumers increased 17.9%, 22.3%, and 19.1%, respectively, while revenues from the three classes of service increased 23.1%, 29.6%, and 27.8%, respectively. Revenues from all sales to ultimate consumers increased 25.7%, amounting to $80,429,868.

News notes

Construction has started on a $190,000, one-story warehouse in Kankakee, Ill., in which the Permaglas-Heating Div. of A. O. Smith Corp. will be able to store more than 15,000 finished water heaters. The new warehouse will double the present inventory-on-hand capacity of 8000 units.

Sales and advertising plans for three recently introduced products of the Bryant Div. of Affiliated Gas Equipment Inc. were

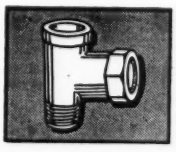


NORMAC
Couplings, Sleeves and Fittings

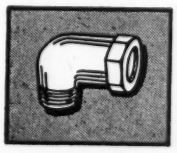
for maximum deflection, ease of "stabbing," complete confinement of the rubber!

So close are "Normac" rubbers confined at the gasket tip that possibility of flow is reduced almost to "nil." These couplings, sleeves and fittings . . . approved by gas utility men across the country for their time-saving features, ease of handling and dependable service . . . are available in a complete range of sizes. Made from air furnace malleable iron they provide greater wall thickness than pipe on which used.

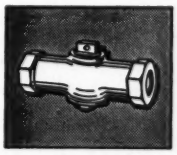
NORMAC COUPLINGS are made with 5" centers in all sizes. NORMAC SLEEVES are identical in design except that they are made with 10" centers. Nuts and gaskets are interchangeable.



Compression-End Service "Tee"—First fitting of this type ever produced with full coupling depth and special threads on male end to prevent dropping into old hand taps when used to replace standard threaded fittings.



Compression-End Service "Ell" — Extra depth makes it possible to "stab" pipe into stops and without measuring, pull back a safe distance to allow ultimate deflection eliminating possibility of strain against tap in main.



Compression-End Iron Body Brass Core Service Stopcocks—End the necessity of threading on the job plus the elimination of the threads themselves—combining all the advantages of NORMAC COUPLINGS and the best in stopcock design. 2½" coupling depth on each end.

Normac Brass Fittings Developed in 1939 for Use with Copper Tubing—Our complete line of brass fittings can be used either on new installations or where copper is run through old steel pipe in large or small openings. The center to end dimensions of NORMAC TEES correspond with old malleable iron fittings. This feature is extremely important in the use of these fittings in one foot openings where the tubing must line up with the steel which has been removed.

Write for the NORMAC CATALOG of Gas Distribution Equipment

NORTON-McMURRAY MFG. CO.

122 SOUTH MICHIGAN AVENUE - - - CHICAGO 3, ILLINOIS

Couplings • Motor Bars • Sleeves • Cocks • Bell Joint Clamps • Service Tees & Ells

Positive Protection!

from *Runaway Pressures! Fires!*

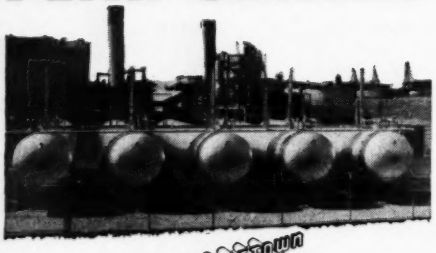
NORWALK POSITIVE PRESSURE CUT OFF VALVES

- **Gives automatic shut off when excessive pressure arises or fire occurs!**
- **Easily reset to desired cut off pressure!**
- **No pressure loss!**
- **All parts external to gas flow!**
- **Quickly reset after operation!**
- **Sizes from 2" to 16"**

SEND FOR FULL PARTICULARS

NORWALK VALVE COMPANY
South Norwalk, Connecticut

PEAK SHAVER



BY DRAKETOWN ®

This packaged propane plant designed, engineered and built by Draketown, provides a completely interchangeable fuel for natural gas.

Draketown can design and build one for you, *within your budget,* to take over all or part of your load at the turn of a valve.

STANDBY
AUGMENTATION
100% TOWN OR PLANT SUPPLY

Serving utility and industry for over thirty years

DRAKE & TOWNSEND
INCORPORATED
Consulting • Design • Engineering • Construction
11 WEST 42ND STREET • NEW YORK 36, N. Y.

unveiled at a recent sales conference of Bryant branch managers in Cleveland. The new products—combination home heating and air conditioning equipment, glass lined water heaters, and oil-fired furnaces—will be presented through a comprehensive national advertising program with tie-in point-of-sale promotion materials.

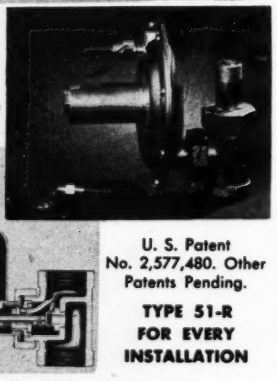
Hamilton Manufacturing Co., Two Rivers, Wis., has appointed Motorola-New York Inc., Long Island City, N. Y., as New York City distributors for its line of home laundry equipment.

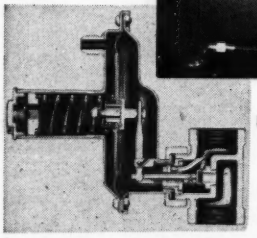
New list prices for Servel gas and electric household refrigerators indicate increases at the retail level of from $10 to $30 for 19 models and a decrease of $10 for one model. President W. Paul Jones pointed out that cost increases have continued to pile up since 1953 prices were announced, necessitating the new prices. Costs of the company's gas and electric water heaters and electric home freezers were not affected.

The Coleman Co., Wichita, Kan., will use three top radio shows over the full NBC network for a special fall selling campaign at the peak of the heater-buying season in a concentrated four-week program. Beginning Sept. 15, gas and oil space heaters will be featured over all of the network of 216 stations except in about 40 cities in the South and Southwest where, because of market conditions, wall heaters and floor furnaces will be promoted. The Coleman dealers of southern California have launched their second campaign to increase the sale of heating equipment, and are aiming at replacing the 900,000 unvented heaters now operating in the area with new, properly adjusted, vented heating equipment .

UNIVERSAL
GAS SERVICE REGULATORS FOR CONVERSION OR PRESSURE ELEVATION

A REGULATOR, BREATHER VENT AND CATHODIC INSULATOR IN ONE PACKAGED UNIT





U. S. Patent No. 2,577,480. Other Patents Pending.

TYPE 51-R FOR EVERY INSTALLATION

EXCLUSIVE FEATURES NOT FOUND ELSEWHERE!

Exceptionally high relieving capacity obtained by new type internal relief valve. Remarkable by-pass check valve prevents over-shooting of low pressure and damage to meter.

SEND FOR BULLETIN NO. 521

UNIVERSAL
CONTROLS CORPORATION
731 WEST DAVIS STREET • DALLAS 8, TEXAS

Last month conversion of household appliances got underway in Watertown, N. Y., to burn the natural gas coming there from a point 54 miles southwest of the city.

Dearborn Stove Co., of Dallas and Chicago, has purchased the Odin Stove Manufacturing Co., Erie, Pa., manufacturers of gas and electric ranges and clothes dryers. Facilities involved include the Odin factory consisting of 84,000 sq ft of manufacturing space and executive offices in Erie.

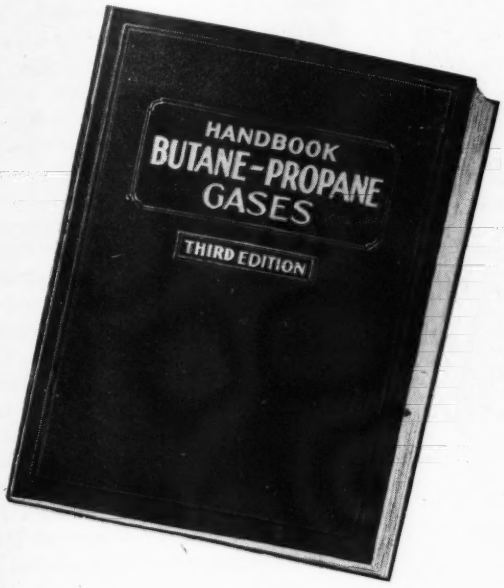
Model in Pied Piper costume displays large Pied Piper doll, badge, official-size football, flutes, and hats, which are among the lures offered as give-aways and prizes by Cribben & Sexton Co. in its tie-in promotion program with this year's Old Stove Roundup.

Long Island Lighting Co., Mineola, N. Y., intends to file revised gas rates which would reduce bills for househeating by about $200,000 annually.

South Jersey Gas Co., Atlantic City, is the 23rd gas utility to adopt the gas advertising character, Handy Flame, as its company spokesman. The character was first introduced in 1947 by the North Shore Gas Co., Waukegan, Ill., according to its creator, W. H. Rohr Jr. (See *GAS,* March 1953, p. 50.)

Haartz-Mason Inc., Watertown, Mass., has announced the formation of a new mechanical products division. T. H. McConnell Jr.,

The Only Complete Reference Book on Liquefied Gas Engineering, Installation and Operation



352 PAGES of Technical Facts, Charts, Diagrams, Photographs, Including Latest Processes and Materials.

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The ABC of L. P. Gas

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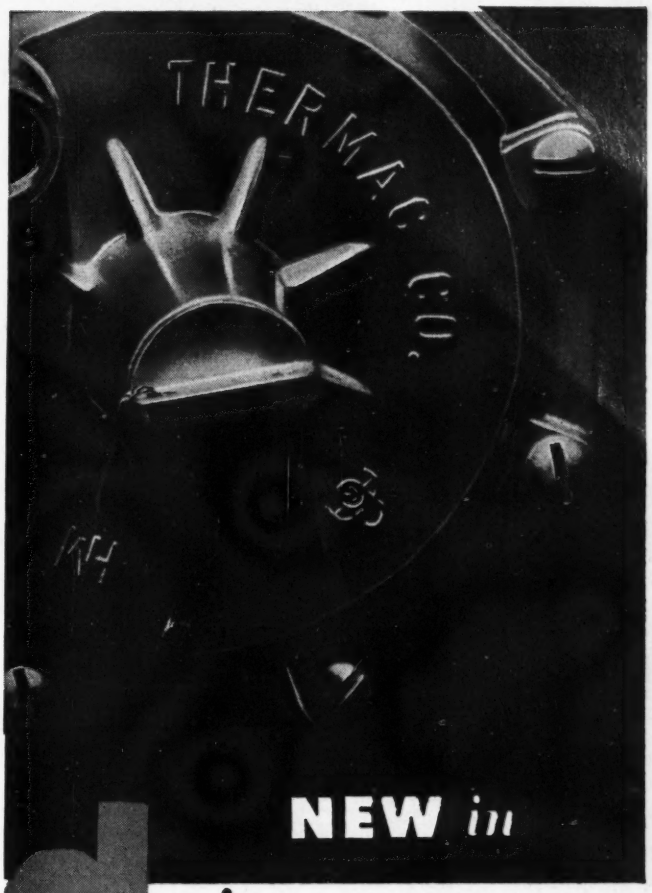
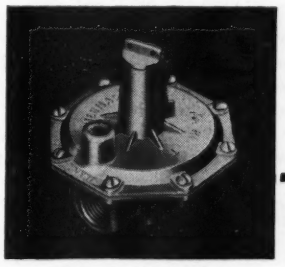


NEW in design-

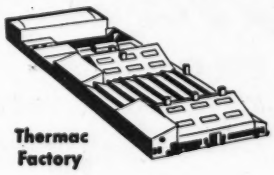
PERFORMANCE

Leadership in the industry demands that we constantly improve both our product and service. The new Thermac 8-sided Appliance Regulator achieves relatively larger effective diaphragm area with resultant higher capacities with relation to its outside dimensions. Greater sealing against diaphragm leakage, easier to install in tight spots, plus provision for vise grip are new special features.

Here in the new "T" Series you have a smaller regulator with more capacity at a lower price and of the highest quality obtainable. Send for our new catalog giving complete data.



Thermac "T" Series Appliance Regulator



Thermac Factory

SEND FOR NEW RATINGS

THERMAC HM COMPANY

800 East 108th Street
Los Angeles 2, Calif.

former supervisor of sales for Vulcan Rubber Products, will serve as general manager of the new division, which will manufacture precision molded diaphragms and rubber coated fabrics for a variety of industrial applications.

In the first half of 1953 the $252 million Wellington Fund purchased natural gas stocks with a market value of $7,730,350, constituting 3.06% of the fund's total assets. One of the largest mutual investment companies in the country, the fund purchased 4000 shares of Chicago Corp., 20,000 shares of Lone Star Gas Co., and 1000 shares of Republic Natural Gas Co. In addition to the above companies, United Gas Corp., Peoples Gas Light & Coke Co., Consolidated Natural Gas Co., and American Natural Gas Co. are represented in the Wellington portfolio.

Adoption of the Commercial Credit Plan has been annouced by Hamilton Manufacturing Co. to enable its home laundry equipment dealers to handle installment sales financing. Through the Commercial Credit Corp. plan, dealers will be able to finance purchases of major items from Hamilton distributors, without capital investment. It also enables dealers to carry an adequate inventory without serious shrinkage of working capital.

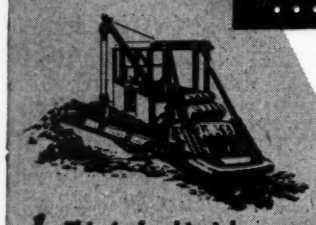
One of the country's newest planned communities, the Bayberry development in New Rochelle, N. Y., features completely modern kitchens with built-in gas cooking equipment. Each of the 200 homes in the new development will contain a Chambers In-A-Wall oven and On-A-Top four-burner cooking unit.

A nationwide survey just completed by the *Journal of Housing*, official publication of the National Assn. of Housing Officials, reveals that the Servel gas refrigerator is one of the two most popular makes of refrigerators for public housing projects. The survey showed that 19,034 refrigerators—or about one out of every four refrigerators installed in the 76,788 units surveyed—were Servels. The states of Alabama, Arkansas, California, Colorado, Georgia, Indiana, Massachusetts, Mississippi, Missouri, Nevada, New Hampshire, Tennessee, and Wisconsin placed Servel in the No. 1 position.

It takes a FULL team

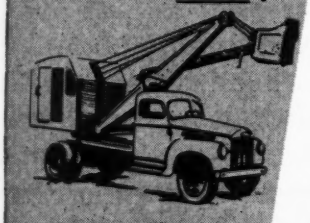
. . . whether it's surgery

. . . or digging equipment



1. This is for big jobs

2. This is for medium jobs



3. Sherman for all other jobs

On many excavating jobs the use of big equipment is costly and time-consuming. The Sherman Power Digger is designed so that you get all the advantages of power digging on these jobs. Thousands of users have proved that the Sherman Power Digger reduces costs. Write today for descriptive literature J6.

Designed, Engineered and Manufactured Jointly by

SHERMAN PRODUCTS, Inc.
Royal Oak, Michigan

WAIN-ROY CORPORATION
Hubbardston, Mass.

•

Patent No. 2,303,825
Other patents pending

Sherman
PRODUCTS, INC.
ROYAL OAK, MICHIGAN

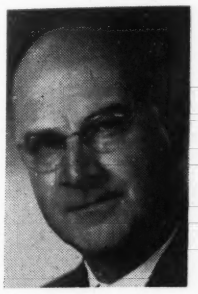
Paul Inskeep (right), director of sales for Detroit-Michigan Stove Co., points to a range top display featuring Dorothy Kilgallen, newspaper columnist and TV personality, who will play a prominent part in the firm's fall advertising and merchandising program. Looking on from left are E. C. Barrows, advertising manager; Milton Ellert, sales manager; and Fred Kaiser, vice president.

The National Safety Council's award of merit, the seventh in 20 years, was presented to the Philadelphia (Pa.) Electric Co. last month for noteworthy performance in the field of safety for the year 1952. To qualify for the award, Philadelphia Electric achieved a lower lost-time accident rate last year than the average for the preceding three years.

The bi-weekly employee publication of Servel Inc., *Servel Inklings*, has won a national award offered by the Red Cross to newspaper-type industrial house organs for the best front page devoted to the Red Cross fund campaign. A special plaque was presented to Miss LaVerne Heady, the editor.

ASSOCIATIONS

J. S. Moulton



W. C. Mainwaring

PCGA celebrates 60th year during September meeting

Celebrating its 60th anniversary of service to the gas industry on the Pacific Coast, the Pacific Coast Gas Assn. held its annual convention in San Francisco this month, with sessions alternating between the Fairmont hotel and the Mark Hopkins.

New officers for 1953-54 are W. C. Mainwaring, British Columbia Electric, Vancouver, succeeding J. S. Moulton, Pacific Gas & Electric, as president; Emery D. Sherwin, San Diego Gas & Electric, vice president; and Harry McGann, PG&E, re-elected treasurer.

One of the highlights of the convention was a historical pageant, "It Started One Hundred Years Ago," written and enacted by members of the PG&E sales organization, commemorating the 100 years of gas service on the coast provided by PG&E and its predecessors.

Among speakers were Sen. Thomas H. Kuchel (R.-Calif.), who spoke on "The State of the Union"; J. F. Donnelly and Frank C. Smith, GAMA and AGA presidents, respectively, who reviewed the gas industry development program; and Gerry Swinehart, president of Carl Byoir & Associates, whose talk was titled "The Sleeping Giant Awakens."

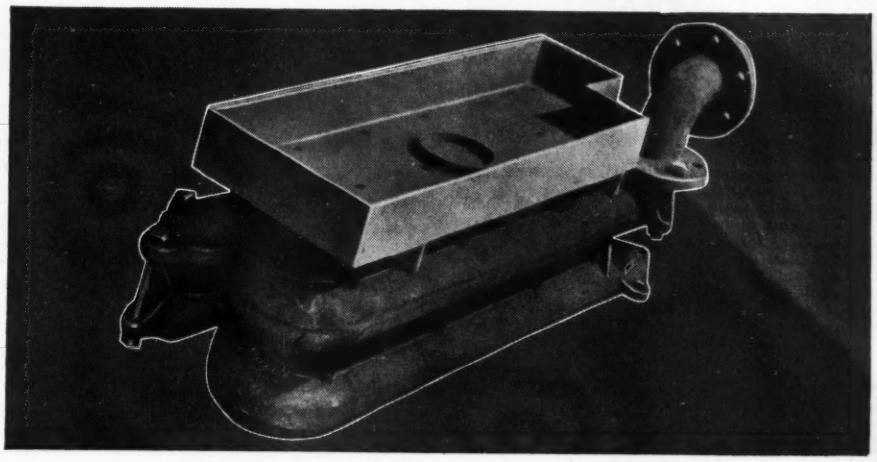
Five new members were honored with membership in the '49ers Club. They are W. M. Jacobs, Southern California Gas Co.; C. P. de Jonge, San Diego Gas & Electric Co.; H. L. Farrar, Pacific Public Service Co.; R. D. MacMahon, SoCal; and Elting Henderson, SoCal.

FPC chairman to address AGA convention session

A discussion by FPC Chairman Jerome K. Kuykendall on the commission's activities as they relate to the natural gas industry and gas distributing companies will be among the highlights of the 35th annual convention of the AGA when it gets under way in St. Louis Oct. 26-28.

Robert W. Otto, chairman of the general convention committee, has announced that experts will review accident and health insurance, public relations, promotion, natural

FOR EASIER MAINTENANCE...



use corrosion resistant, easy-to-clean

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on NATIONAL COOLING and CONDENSING SECTIONS

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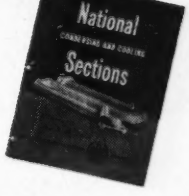

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gas pipeline operation and maintenance, and government controls, in addition to a variety of currently provocative industry matters. Nationally known speakers will address the three general sessions to be held in the Opera House of Kiel Auditorium.

State control will also be on the program, when Eugene S. Loughlin, president of the National Assn. of Railroad & Utilities Commissioners and chairman of the Connecticut Public Utilities Commission, discusses " 'States' Rights'—Its Privileges and Responsibilities."

Other program highlights will be a review of the progress of the gas industry development program. In line with this, a new departure will be inaugurated whereby spokesmen will sound off on the industry's future at a "Coats Off for Action" luncheon. Facets of the development program will be discussed at this wind-up luncheon which will be presided over by AGA President Frank C. Smith.

Achievements of all branches of the industry will be keynoted by three spokesmen who are members of the AGA board of directors. Dean H. Mitchell, Northern Indiana Public Service Co., will speak for the utilities; James F. Oates Jr., Peoples Gas Light & Coke Co., will discuss PAR and public relations; and Lyle C. Harvey, Affiliated Gas Equipment Inc., will represent gas appliance manufacturers.

The new Hasche gas maker installed by Peoples Water & Gas Co., North Miami, Fla., as a standby operation can produce 2 MMcf of gas per day from liquid propane.

NACE makes plans for fall meetings and short courses

Plans for two short courses and three meetings for the fall have been announced by the National Assn. of Corrosion Engineers.

What is believed to be the first short course on cathodic protection offered by an American university will be co-sponsored by NACE and the University of Illinois Oct. 12-16 at Urbana, Ill. Subjects will range from how to install a cathodic protection system to how to finance the installation.

Also on the schedule is the four-day A & M corrosion short course at A & M College of Texas, College Station, Sept. 22-25. The course, with experienced corrosion engineers among the chief teachers, will be given by the south central region of NACE in cooperation with the chemical engineering department of the college.

The 1953 fall conference of the western region will feature meetings of two technical practices committees and two technical sessions. The meeting will be held Nov. 19-20 at the Biltmore hotel, Los Angeles.

Sept. 30-Oct. 2 are the dates for the 1953 Permian Basin corrosion tour sponsored by the Permain Basin section of NACE. Headquarters will be in the Lincoln hotel, Odessa, Texas.

The third fall meeting announced is the south central region session scheduled for Oct. 7-9 at the Mayo hotel in Tulsa. This will feature an open session of a technical practices committee, a pipeline corrosion forum, and three symposia.

AGA announces staff appointments, promotions

Several staff appointments were announced last month by the AGA. On Oct. 1, Curtis Morris, formerly a vice president of Transcontinental Gas Pipe Line Corp., Houston, will begin a study of AGA's facilities and services devoted to natural gas production

Curtis Morris

and transmission in order to determine how the association can be of the greatest possible usefulness to producing, transmission, and distributing natural gas companies.

The association has also announced that Otto E. Zwanzig, formerly director of the bureau of statistics, has been appointed full-time director of the PAR program. Previously, PAR activities were directed on a part-time basis by John W. West Jr., who now assumes direct responsibility under the managing director for all headquarter activities other than the PAR plan and those of the AGA corporate secretary. Daniel Parson, former senior statistician, will succeed Mr. Zwanzig as director of the bureau of statistics.

Gerson L. Skinner has joined the AGA headquarters staff as a member of the field representatives project.

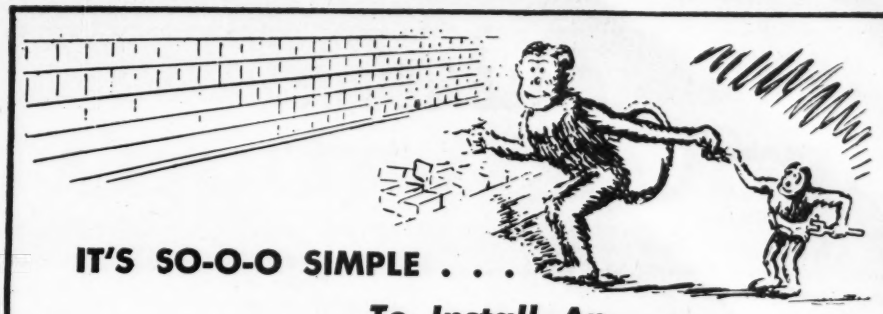
Otto Zwanzig

Daniel Parson

Panels will highlight National Safety Congress

Highlighting the public utilities sessions of the 41st National Safety Congress and Exposition to be held in Chicago, Oct. 19-23, will be a panel discussion and demonstration on how to cut down fleet accidents. It is expected that the 1953 exposition will feature the largest and most comprehensive display of accident prevention equipment to be seen anywhere. All exhibit space in the Conrad Hilton hotel will be filled with products, equipment, and services relating to the promotion of safety, health, first aid, sanitation, and general welfare.

The panel discussion showing how the Cincinnati & Suburban Bell Telephone Co.'s motor vehicle accident reduction program works will be chairmanned by M. McComas,



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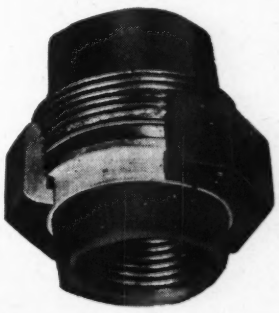

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OMAHA, NEBRASKA

CALENDAR

September

1-2....AGA - NEGA Conference — Boston.

9-11..Pacific Coast Gas Assn. Annual Convention—San Francisco.

10-11..Midwest Gas School and Conference — Iowa State College, Ames.

11..NEGA Industrial Division — Wachusett Country Club, West Boylston, Mass.

11..New Jersey Gas Assn. — Spring Lake, N. J.

11..Southern Gas Assn. Distribution Operating Problems — Texas Hotel, Fort Worth.

18..Southern Gas Assn. Employee Relations Conference—Read House, Chattanooga.

22-25..A & M Corrosion Short Course — A & M College of Texas, College Station, Tex.

25..SGA Compressor Station Conference — Captain Shreve Hotel, Shreveport.

26..SGA Transmission Section Round-Table on Rights-of-Way Problems — Tutwiler Hotel, Birmingham, Ala.

27-30..Controllers Institute of America—Hotel Statler, Boston.

28-29..Independent Natural Gas Assn. of America Annual Meeting — Shamrock Hotel, Houston.

30-2..National Assn. of Corrosion Engineers 1953 Permian Basin Corrosion Tour — Lincoln Hotel, Odessa, Tex.

October

2..SGA Right-of-Way Conference — Peabody Hotel, Memphis.

6-7....Texas Mid-Continent Oil & Gas Assn. — Rice Hotel, Houston.

7-9....NACE South Central Region — Mayo Hotel, Tulsa.

12-16..NACE Short Course on Cathodic Protection — University of Illinois, Urbana.

15..NEGA Operating Division — Hotel Kimball, Springfield, Mass.

19-21..35th Annual Meeting, American Standards Assn.—Waldorf-Astoria, New York.

19-23..National Metal Exposition—Public Auditorium, Cleveland.

19-23..National Safety Council — Conrad Hilton, Congress, Morrison, and Sheraton hotels, Chicago.

20..NEGA Accounting Division—The Sheraton-Biltmore, Providence, R. I.

26-28..AGA Annual Convention — Kiel Auditorium, St. Louis, Mo.

November

5..NEGA Safety Conference — Hotel Statler, Boston.

6..SGA Residential Sales East Conference — W. R. Barringer Hotel, Charlotte, N. C.

9-12..API — Conrad Hilton and Palmer House, Chicago.

9-13..National Hotel Exposition — Kingsbridge Armory, New York.

11-13..Wisconsin Utilities Assn. — Hotel Schroeder, Milwaukee.

13..SGA Residential Sales West Conference — Adolphus Hotel, Dallas.

18-20..Mid Southeastern Gas Assn. —Sir Walter Hotel, Raleigh, N. C.

29-4..American Society of Mechanical Engineers — Statler Hotel, New York.

December

1-4..University of Oklahoma Corrosion Conference — University of Oklahoma, Norman.

1954

March

4-5..AGA Transmission and Storage Conference — Jung Hotel, New Orleans.

15-17..Mid-West Gas Assn.—Fort Des Moines Hotel, Des Moines, Iowa.

25-26..New England Gas Assn. — Hotel Statler, Boston.

April

12-14..National Conference of Electric & Gas Utility Accountants—Hotel Statler, Boston.

13-15..Oklahoma Utilities Assn. Southwestern Gas Measurement Short Course — University of Oklahoma, Norman.

20-23..AGA Distribution, Motor Vehicles, and Corrosion Conference—Mount Royal Hotel, Montreal, Canada.

22-23..Indiana Gas Assn. Annual Meeting.

26-28..Mid-West Regional Gas Sales Conference — Edgewater Beach Hotel, Chicago.

26-28..Southern Gas Assn. Annual Convention—Houston.

May

10..AGA Commercial Gas School — Chicago.

9-12..LPGA Convention — Conrad Hilton Hotel, Chicago.

19-21..GAMA Annual Meeting — The Drake Hotel, Chicago.

24-26..AGA Production and Chemical Conference — William Penn Hotel, Pittsburgh.

27-28..Natural Gas & Petroleum Assn. of Canada — Prince Edward Hotel, Windsor, Ontario, Canada.

assistant secretary of the company. Public utilities safety men attending the Thursday afternoon session will see a demonstration-discussion on how to conduct a safety meeting. Following the demonstration, the members will split up into four groups to consider the specific problems of gas, electricity, water, and communications.

As in previous years, the American Society of Safety Engineers will present morning sessions on topics of general interest.

Market research group to study appliance sales

The American Gas Assn.'s committee on economics has formed a subcommittee on marketing research to provide guidance to the AGA bureau of statistics in the development of appliance sales potentials. The new group, under the chairmanship of F. B. Jones, Equitable Gas Co., will also promote marketing studies in connection with the gas industry development program. Committee members include the following:

Hale A. Clark, Michigan Consolidated Gas; J. S. Cooke, Laclede Gas; Newton Croll, Philadelphia Gas Works; J. R. Guidroz, New Orleans Public Service; J. L. Hall, Southern California Gas; R. I. Mendes, Pacific Gas & Electric; G. A. Morgan, Peoples Gas Light & Coke; D. L. Sedgwick, Northern Natural Gas; H. A. Weitzman, Rochester Gas & Electric; J. A. Wilson, United Gas Corp.; Daniel Parson, AGA, secretary.

NACE names new chairman for technical committees

Changes in the technical committees of the National Assn. of Corrosion Engineers included the naming of H. W. Schmidt, Dow Chemical Co., chairman of the over-all technical practices committee. Also chosen were R. C. Buchan, Humble Oil & Refining Co., chairman, and E. C. Greco, United Gas Corp., vice chairman of the committee on corrosion of oil and gas well equipment.

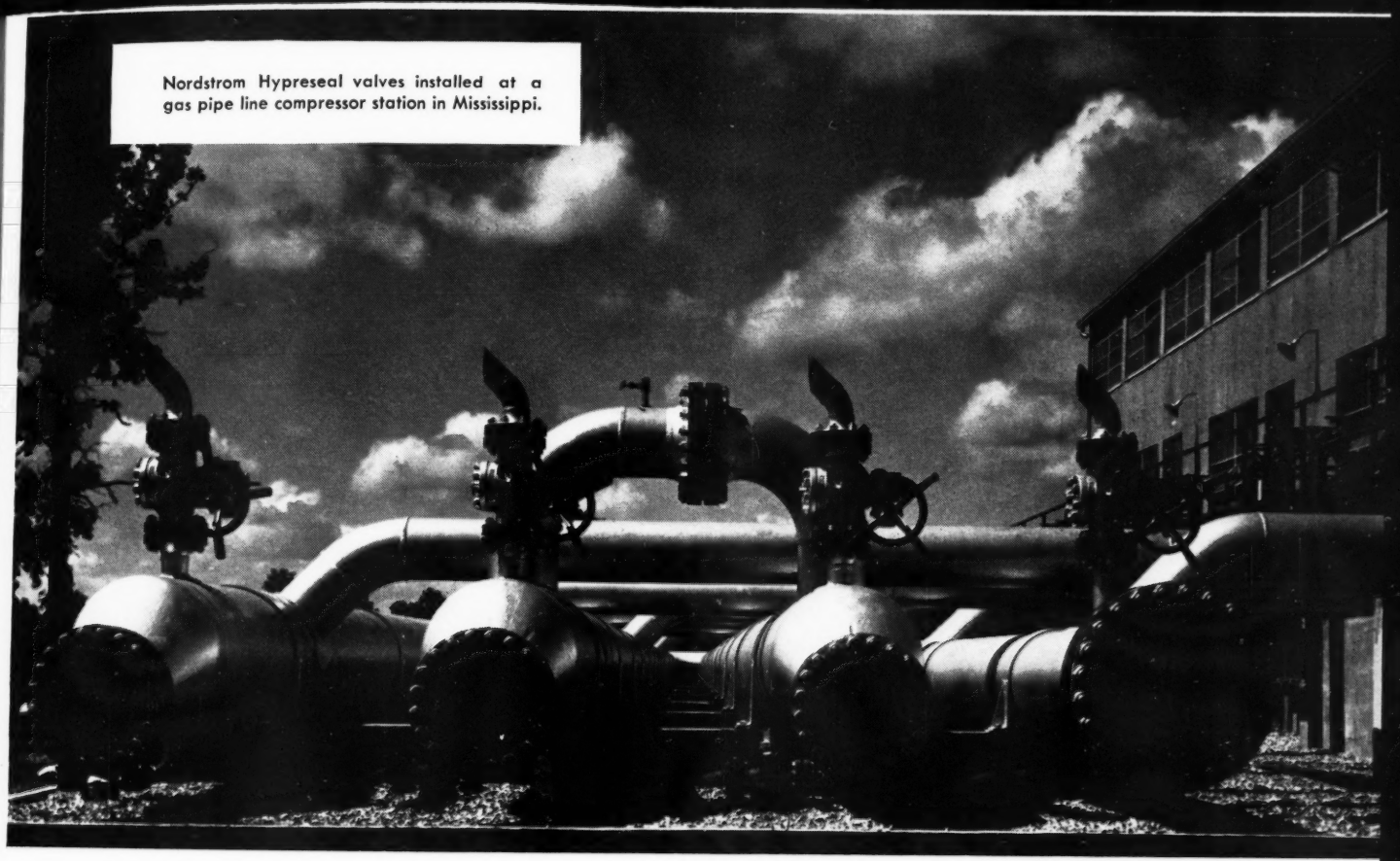
L. P. Sudrabin, Electro Rust Proofing Corp., is chairman of the committee on minimum current requirements for cathodic protection, and A. J. Liebman, Dravo Corp., is vice chairman of protective coatings.

Utilities will vie for commercial cooking awards

In conjunction with the AGA's PEP sales campaign in September, October, and November, the Gas Appliance Manufacturers Assn. will conduct a contest among the nation's gas utilities to promote the sale of commercial gas cooking equipment. Three divisional prizes will be awarded to the utilities which sell the greatest dollar volume of commercial gas cooking equipment during the three-month period.

Utilities which have registered in the AGA Performance Economy Profit sales campaign will be eligible for a plaque and $300 cash award within the following three divisions: Large, 100,001 or more domestic meters; medium, 25,001 to 100,000 domestic meters; and up to 25,000 domestic meters.

GAS Transmission and Conditioning Section



Nordstrom Hypreseal valves installed at a gas pipe line compressor station in Mississippi.

Why NORDSTROMS Are The *RIGHT* Valve
FOR GAS PIPE LINE SERVICES

There are a number of requirements demanded of valves on gas pipe line services. They must safely carry hard-to-hold gases at high pressures, allow straight-through flow without turbulence, operate dependably for years without breakdown, be ready to open or close quickly and easily at any time and, of course, must give a positive closure that prevents internal and external leakage. Only Nordstrom Lubricant-Sealed valves meet all of these requirements.

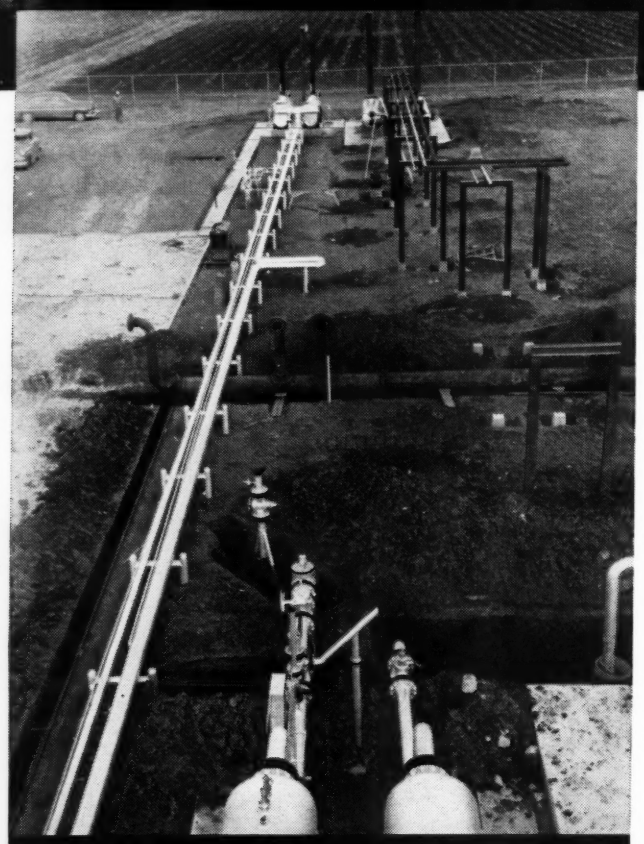
In a Nordstrom valve, a film of pressurized lubricant covers the seating surfaces preventing leakage and protecting these vital areas from wear. This lubricant also keeps the valve ready to open or close with a quick quarter turn even after long periods of time in one position. Contact your Nordstrom representative for further information on why Nordstrom valves are best for your pipe line services. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL Built Nordstrom Valves

Lubricant-Sealed for Positive Shut-Off

Another ROCKWELL Product

Two 50 M²CFD National Units
at Baxterville Dehydration Plant



National Heaters and Piping for one 50 M²CFD
National Unit at Houma Dehydration Plant

World's Largest

HANDLER OF NATURAL GAS USES NATIONAL DEHYDRATION UNITS

All of the ten new plants being built or enlarged by this company in its expansion program will utilize National Dehydration Units exclusively. Capacities of these plants will vary according to volume requirements.

National Tank Company Dehydration Units are available in sizes and capacities to fit customer requirements. All units are skid mounted and fully automatic.

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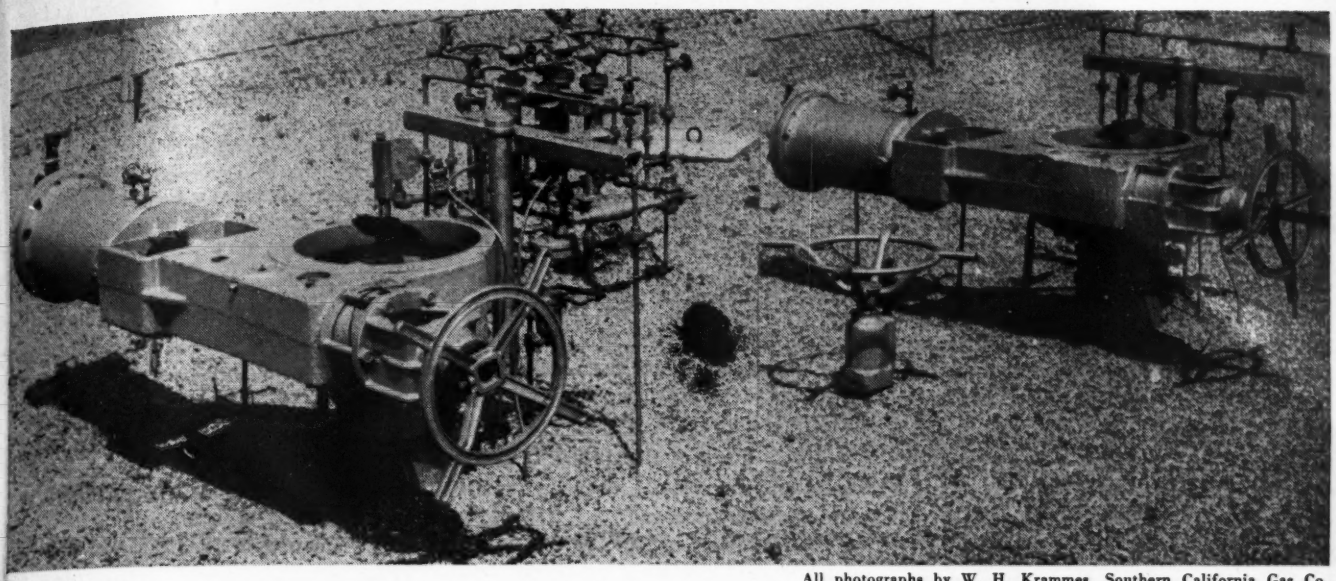


All photographs by W. H. Krammes, Southern California Gas Co.

Fig. 3. A pair of remotely controlled, piston operated pressure control valves.

Positioning of piston operated valves

By F. M. PARTRIDGE and G. C. WILSON • Southern California Gas Co.

FROM time to time attempts have been made to use plug valves as regulators in order to achieve the following objectives: (1) to minimize pressure drop through the valve under wide-open conditions, and (2) to solve the noise problem in an indirect way by burying the plug valve and operating it through extended gearing. This plug valve pressure control has been accomplished in a more or less satisfactory way by using air motors or electric motors operating through suitable gearing and controlled by one of several different methods.

One of the early installations of this type was at the Pacific Gas & Electric Co. Milpitas gas terminal.[1] In this installation a 22-in. plug valve was positioned through gearing by an electric motor. This was a remote control unit rather than an automatic control as no pressure or volume controller was used.

Spence station, the original terminus of the first Texas-California gas pipeline, presented a rather serious problem because of the high sound levels produced by the large volumes of high pressure gas passing through the conventional double ported regulators. This noise problem was overcome in an acceptable manner by constructing insulated double-windowed buildings around the first and second stage regulators. Because of the high cost of this type of construction, investigations were continued in an effort to find a less costly and more satisfactory solution to the noise problem.

Following a suggestion for using buried plug valves as pressure regulators, a more or less satisfactory solution was worked out at Crenshaw station, a secondary terminus of the Texas pipeline system. At this station the buried plug valves were positioned by air motors (utilizing gas pressure) operating through suitable gearing units. To minimize "over-shooting" and "hunting," an "intermitter" was included in the setup to cause the valve to move slightly and then pause for a sufficient time to compensate for the system time lag before

[1] *Design for a Remote Control Pressure Station*; Proc. PCGA, Vol. 29 (1938) p. 75.

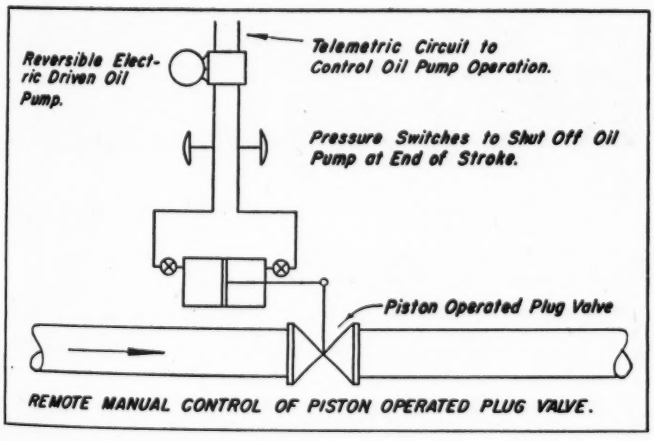
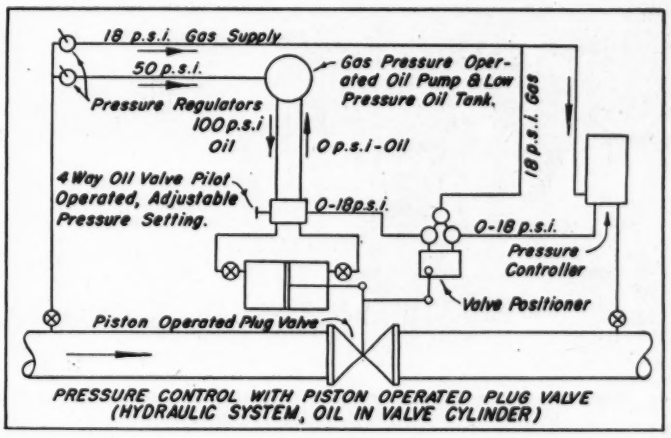

Reversible Electric Driven Oil Pump.
Telemetric Circuit to Control Oil Pump Operation.
Pressure Switches to Shut Off Oil Pump at End of Stroke.
Piston Operated Plug Valve
REMOTE MANUAL CONTROL OF PISTON OPERATED PLUG VALVE.

Fig. 1.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50 p.s.i.
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0-18 p.s.i.
0-18 p.s.i.
Pressure Controller
Valve Positioner
Piston Operated Plug Valve
PRESSURE CONTROL WITH PISTON OPERATED PLUG VALVE (HYDRAULIC SYSTEM, OIL IN VALVE CYLINDER)

Fig. 2.

moving again, if necessary. While this installation was fairly satisfactory and is still in operation, the complexity of the controls, the wide pressure variations, and the slow response left considerable room for improvement.

It was felt that in order to attain stable control of pressure or volume, some type of valve positioner would be necessary. The valve positioner causes the valve to move an amount proportional to the deviation from the set point and thus eliminates much of the hunting or "cycling" which occurred in previous systems. For any given controller output pressure, the valve will assume a corresponding position.

This type of control was used at the western terminal station of the Southern California Gas Co.[2] The valves are positioned by electric motors through suitable gearing and are controlled by an electronic type of valve positioner, which has done a satisfactory job on both pressure and volume control. While this installation has operated in a very satisfactory manner, the relatively complex controls have occasioned rather high maintenance charges.

Valves as regulators

Engineers have often toyed with the idea of using a piston operated plug valve for throttling purposes. Experience had shown, however, that it is very difficult to accurately position the valve with a piston. Because of leakage past the piston cups, the static friction of the valve and cylinder and the compressibility of the gas in the cylinder, it has been found almost impossible to stop the valve once it starts to move. If these three problems could be solved, then it would become possible to not only use plug valves as regulators in new stations but also to install cylinders on existing valves and use them for control purposes. The conversion of an existing valve to a control valve without taking it out of service at the relatively low cost of a power cylinder and positioning equipment is an attractive proposition.

The first attempts to accomplish the desired valve control were made using a pneumatic valve positioner and a 4-way valve with gas pressure used to move the piston. While fairly satisfactory outlet pressure control could be attained, it was difficult to eliminate the constant hunting of the valve. The maintenance of the piston cups and gas leakage past the piston were other factors which would make this type of control unsatisfactory.

There are two different objectives desired in positioning valves for throttling purposes. The first and perhaps simplest is remote valve positioning. In this case the valve is positioned from some remote location at any desired percentage opening in a manner similar to hand control or "hand feeding" by a human operator at the valve location. This operation is desirable in the remote control of valves. When a valve is to be opened between two systems in which there is an appreciable difference in pressure, it is very desirable, if not absolutely necessary to open the valve very slowly and often to hold the valve in an intermediate position. This could be done with a motor-operated gear driven valve, but the use of a cylinder operator offers the advantages of flexibility of operations and the fact that the cylinder operator can often be installed on existing valves without taking them out of service.

To accomplish this positioning using a piston operated valve, oil is pumped from one side of the piston to the other by means of a small aircraft type electric hydraulic pump. Filling the cylinder with oil eliminates the three main difficulties usually encountered in positioning piston operated valves. They are (1) leakage past the piston cups, (2) high static friction, and (3) the compressibility of the gas in the cylinder. The speed of valve movement can be readily controlled by a variable or fixed restriction in the oil line to the cylinder and the valve can be very accurately positioned as desired. Sufficient pressure is made available so that when the pump starts operating, the valve immediately moves because of the relative incompressibility of the oil used. A schematic diagram of the piping arrangement for this method of valve positioning is shown in *Fig. 1.* A reservoir must be supplied for excess oil and the amount of valve movement per unit of time determined for the benefit of the operator. An air powered pump (using gas pressure) could be used for this service but if electric power is required for the telemetric controls, it can be conveniently used for operating a pump.

Automatic pressure

A slightly more complex setup is required in order to position a piston operated valve for pressure or volume control. A pressure controlling setup is shown in *Fig. 2.* A conventional pneumatic pressure controller is used, the output of which feeds into an external lever type of valve positioner which is connected to the valve plug through suitable mechanical linkage. The output of the valve positioner then is connected to operate a 4-way adjustable pilot valve. This valve has a neutral position so that

[2] *Gas Regulation and Noise Control*; Proc. PCGA, Vol. 43 (1952), p. 142.

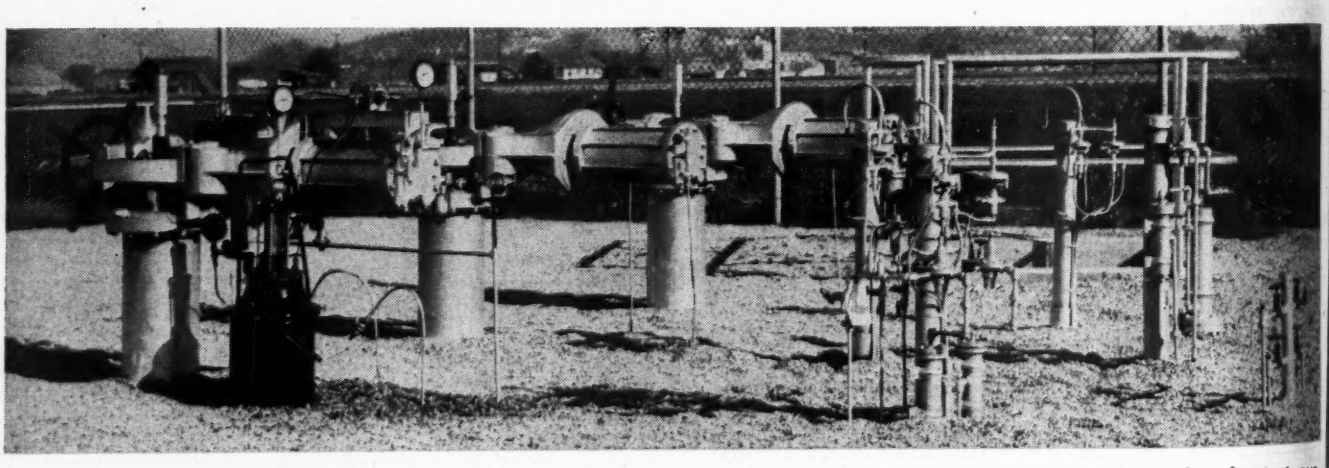

Fig. 4. An oil driven, piston operated valve (left) with two gas pressure driven, piston operated valves located together for test purposes. All three valves are automatically controlled. A black oil reservoir can is located adjacent to the oil driven valve. The oil pump is located atop the can.

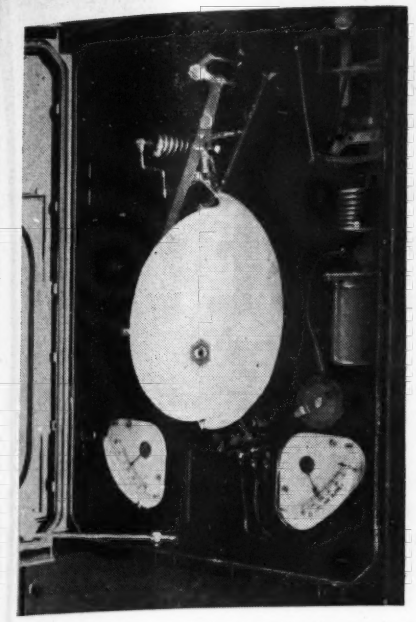

Fig. 7. A telemetrically operated pressure controller.

when the output pressure of the positioner is approximately 8½ lbs, the 4-way valve is closed and the piston operated valve is at rest.

The 4-way valve controls the output of a simple air-liquid reciprocating pump such as is used for pumping heavy oil in a service station. The pump used had a 2-to-1 pressure ratio so that with a gas pressure supply of 50 psi, the pump is always ready to deliver oil at about 100 psi to the supply connection of the 4-way valve. Any time the 4-way valve moves to permit oil to flow into the valve cylinder, the oil pump starts to operate. The oil pump is mounted on a light-weight vessel in which the oil is stored at atmospheric pressure. The vent or exhaust connection of the 4-way valve is connected to this oil reservoir so that exhaust oil from the valve cylinder is returned to storage and re-used. Gas at 50 psi pressure is supplied to operate the reciprocating air-liquid pump and gas at 18 psi is supplied to the valve positioner and to the pneumatic pressure controller.

A photograph showing a general view of the valve location is shown in *Fig. 3* and a closeup of the control equipment is shown in *Fig. 4*. The oil pump, 4-way valve cylinder and temporary connections can be seen in this view.

The pump used in this experimental work is an inexpensive type which has been used successfully for handling lubricants in automobile service stations. Many high quality pumps are available and perhaps a more expensive model would be justified on some installations.

A section of an orifice meter chart from the meter downstream of the control valve is shown in *Fig. 5*, This chart was rotated with a 6-minute rotation clock and clearly shows the smooth pressure and differential lines produced.

The static and differential pressure records during pressure setting changes are shown in *Fig. 6*. The charts are from a 30-in. orifice meter immediately downstream from the test valve which was a 12-in. buried plug valve. The upsets shown on the chart were caused by:

Point	Change
A	Control point raised 5 psi.
B	Control point raised 10 psi.
C	Control point raised 10 psi with oil flow restricted to slow down the piston speed. Each time division on the chart is equal to one minute.

The pressure controller used on this job was arranged so that the set point could be changed from a remote point over a telemetric circuit. The controller is of the "program" type but with a special spiral cam installed in place of the usual "time" cam (see *Fig. 7*). This cam is rotated by means of a reversible direct current motor controlled from a remote location by reversing the direction of current flow in the telemetric circuit.

Oil-operated piston

It is felt that the use of oil in the valve cylinder will make it convenient to accurately position piston operated valves either for remote control or for automatic pressure or volume control and that the following additional advantages can be realized:

1. The oil filled cylinder will greatly reduce required maintenance, particularly of the piston cups.
2. Most valves can be converted to remote or automatic control by installing an operating cylinder and positioning equipment without taking the valves out of service.
3. In case of failure of the oil system, the valve will probably fail in its operating position. This will generally be preferable to the usual control valve which either closes off or opens wide when a control system failure occurs.
4. Complex pressure limiting stations could be eliminated by putting this type of control equipment on a mainline valve.

Some experience has been obtained to indicate that plug valves are quite resistant to abrasive wear on the body and on the plug when used for control work; however, for operations under severe or questionable conditions, it is recommended that provision be made for periodic inspection of the valve interior. This would in some cases require the installation of upstream and downstream block valves and a bypass in a manner similar to conventional regulator installations.

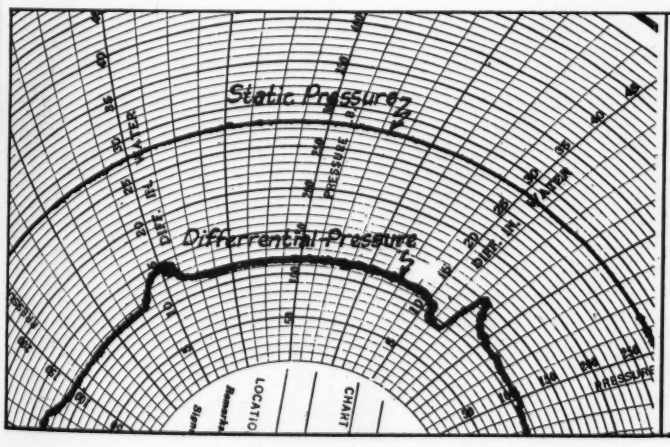

Fig. 5. Section of an orifice meter chart showing flow conditions downstream of experimental plug valve (96-minute chart rotation).

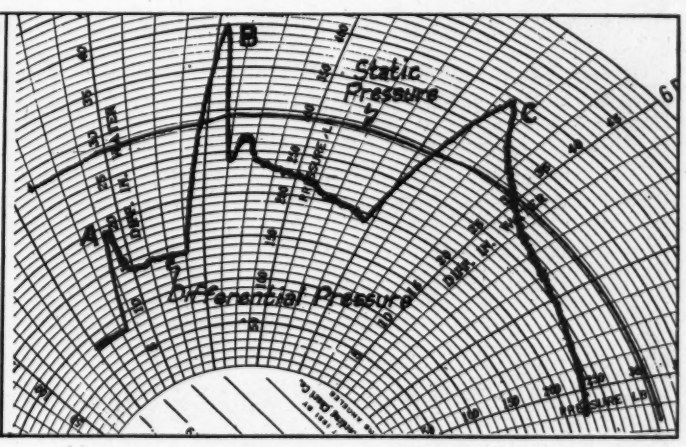

Fig. 6. Orifice meter chart section showing flow conditions when change in pressure setting is made (96-minute chart rotation).

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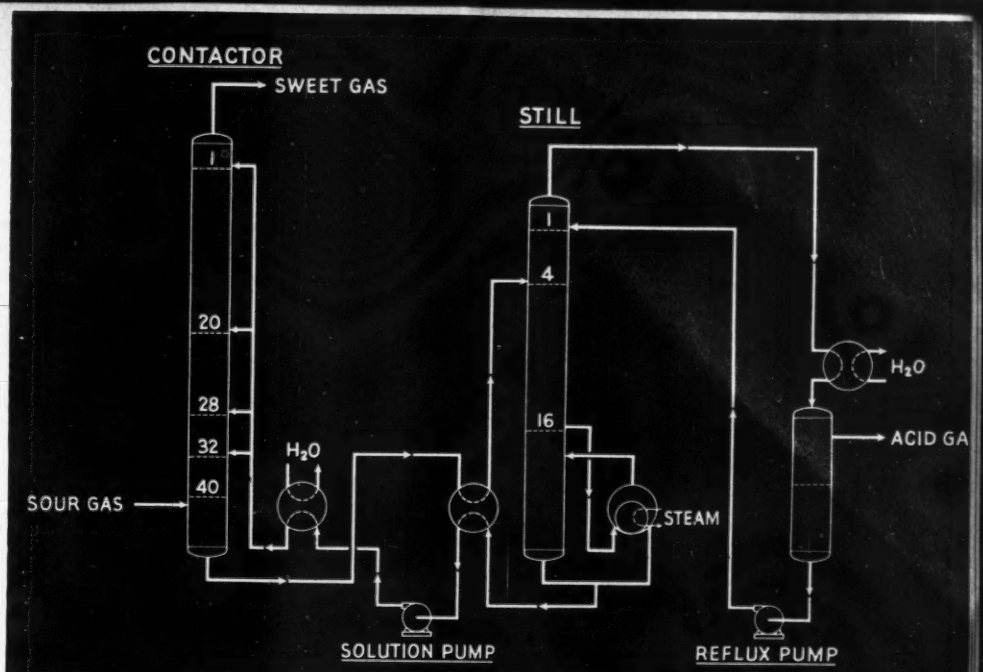

FIG. 1 FLOW DIAGRAM OF GAS TREATING PLANT USED FOR TEST OF MDEA

HOW THE PROCESS WAS DEVELOPED

The treatment of gases with ethanolamines for the removal of hydrogen sulfide and carbon dioxide is a well established industrial process.[1,2] Monoethanolamine (MEA) and diethanolamine (DEA) are the most commonly used amines in this country. The use of a mixed glycol-amine solvent has also acquired large scale application particularly where gas dehydration is required in addition to treating[3,4,5].

The optimum choice of absorbent will depend primarily upon purity requirements and economic considerations. In general, MEA systems are found to produce higher purity gas with regard to H_2S and are preferred for natural gas treating. The use of DEA is now more or less limited to refinery gas processing where the purity requirements are not stringent. Its low vapor pressure and resistance to reaction with COS and CS_2 give DEA some economic advantage over MEA for such installations by reducing losses due to vaporization and side reactions. The overall industrial trend, however, appears to be toward the greater use of MEA. The somewhat higher vaporization losses incurred with MEA can be reduced by the use of a water wash and its greater tendency to react nonregenerably with COS and CS_2 may be largely offset by the fact that it can be readily separated from non-volatile salts and break down products by distillation.

The aqueous and glycol-amine systems using MEA or DEA are essentially nonselective, absorbing effectively both hydrogen sulfide and carbon dioxide from the gas stream. During the course of Fluor's work in the field of gas treating, requests were frequently received for a process which would absorb the H_2S completely, without absorbing all of the carbon dioxide.

Results of commercial tests of selective H_2S absorbent

By F. E. MILLER and A. L. KOHL • The Fluor Corp., Ltd.

OUR initial studies in finding a selective absorbent that would absorb hydrogen sulfide completely without absorbing all of the carbon monoxide in gases consisted of simple laboratory tests on more than 50 different absorbents. This was followed by bench scale glass pilot plant tests and finally by pilot plant studies at pressures up to 750 psig with amines which appeared to be the most promising solvents. Of the chemicals tested, methyl-diethanolamine (MDEA) was found to offer the best combination of properties, and the greatest emphasis was placed on this material. The results of laboratory and pilot plant studies with MDEA have been discussed in previous papers[6,7] and the use of other materials for selective absorption has also been discussed. Now we are able to report the results of the first commercial scale operation with MDEA as carried out in a refinery treating plant which had previously used DEA.

In this particular refinery, the acid gas stream from the DEA stripper was reabsorbed in concentrated MEA solution and transported by tank truck to an MEA stripper located in a chemical plant some distance from the refinery. A relatively small but appreciable quantity of CO_2 in the refinery gas stream was also being picked up by the DEA and reabsorbed in the MEA system. As CO_2 is not readily stripped from MEA, this component had built up in the MEA stream, decreasing its capacity for H_2S and thereby increasing the quantity of MEA required and affecting the cost of trucking. On the basis of our pilot plant experience with MDEA, it was suggested that this material be tried in place of DEA in the existing refinery treating plant.

It was realized that this plant did not present optimum conditions for operation with a selective solvent principally because the feed gas contained considerably more H_2S than CO_2. However, the unit was relatively small, and it was decided to proceed with the test on a cooperative experimental basis. Prior to the solution changeover some minor equipment changes were made to improve operation, and the plant was thoroughly cleaned and inspected for corrosion. Corrosion coupons were placed in the reboiler, exchanger, cooler and other critical locations in the plant in order to ob-

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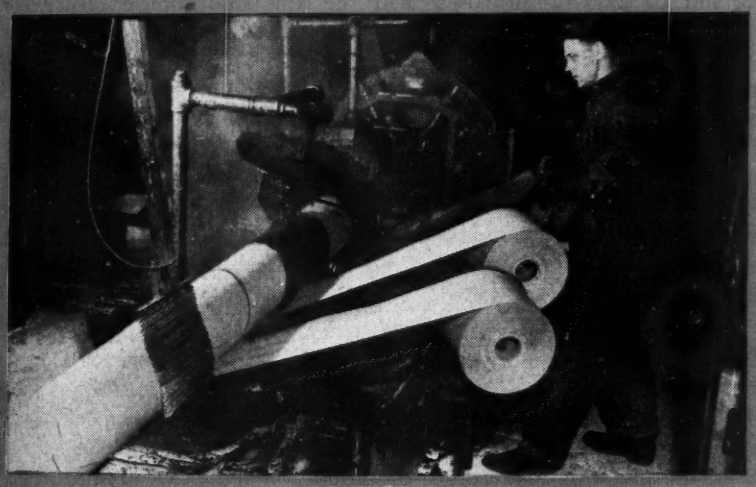

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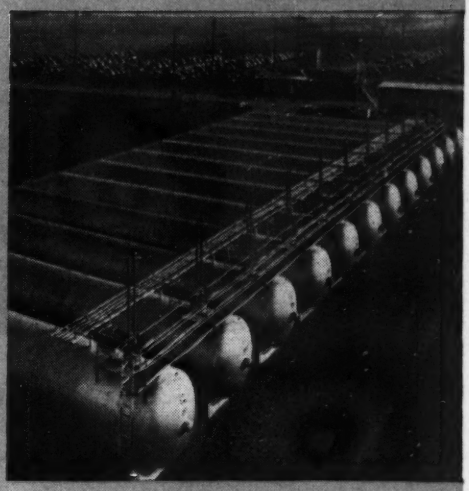

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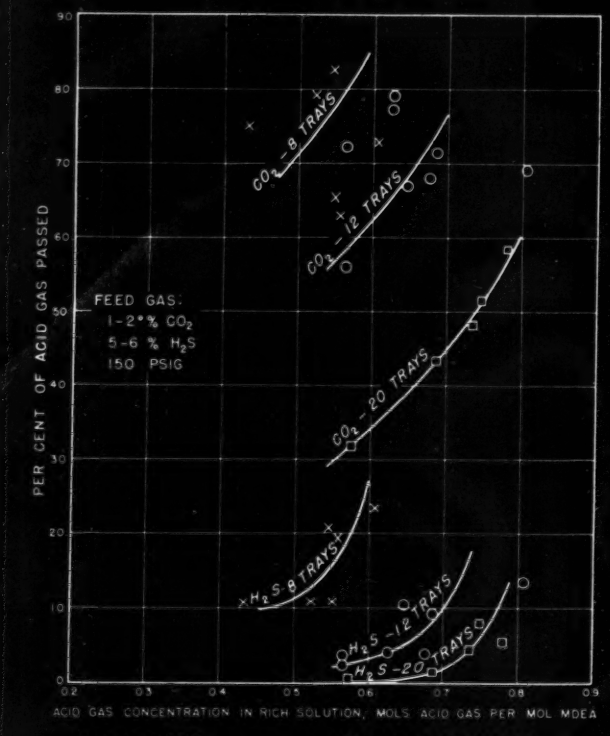

PER CENT OF ACID GAS PASSED
ACID GAS CONCENTRATION IN RICH SOLUTION, MOLS ACID GAS PER MOL MDEA
FEED GAS:
1-2% CO2
5-6 % H2S
150 PSIG
CO2 - 8 TRAYS
CO2 - 12 TRAYS
CO2 - 20 TRAYS
H2S - 8 TRAYS
H2S - 12 TRAYS
H2S - 20 TRAYS

FIG. 2 EFFECT OF SOLUTION CONCENTRATION AND NUMBER OF TRAYS ON ABSORPTION

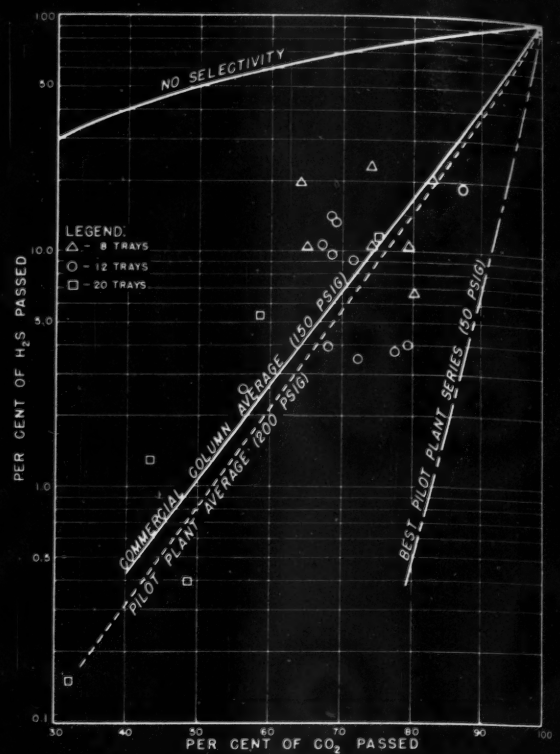

NO SELECTIVITY
LEGEND:
△ - 8 TRAYS
○ - 12 TRAYS
□ - 20 TRAYS
COMMERCIAL COLUMN AVERAGE (150 PSIG)
PILOT PLANT AVERAGE (200 PSIG)
BEST PILOT PLANT SERIES (150 PSIG)
PER CENT OF H2S PASSED
PER CENT OF CO2 PASSED

FIG. 3 SELECTIVITY OF MDEA SOLUTION

tain some measure of the corrosiveness of MDEA solutions under actual plant conditions.

The plant

Fig. 1 represents a simplified flow diagram of the treating plant used for the MDEA test. The flow arrangement is typical for a gas treating plant. The contactor consists of a 40-tray bubble cap column to which the solution can be fed on the first, 20th, 28th, or 32nd tray from the top. The still consists of a 16-tray column to which the rich solution is fed on the fourth tray. Reflux is admitted to the top of this column.

The contactor pressure was maintained at 150 psig during the test, the same as for the previous DEA operation, and the still was operated at 10-15 psig. A treating solution containing about 20% MDEA in water was used. The plant operated quite smoothly during most of the test period. Some indication of foaming was encountered, particularly in the still. However, this was overcome by the addition of a foam inhibitor (octylphenoxyethanol). During the test period the gas feed rate and acid gas concentrations varied considerably as refinery operations were altered. This allowed many of the variables to be tested under a wider range than would normally be possible in a commercial plant.

Typical operating data obtained from the treating plant using MDEA are presented in *Table 1*. As can be seen, runs in which 8, 12, and 20 trays of the contactor were used are tabulated. Some information was also obtained with the full 40 trays of the column being used for absorption. The data from these tests were quite erratic because the large quantity of liquid hold-up in the column did not permit steady state to be reached. However, in general, the results with 40 trays were not greatly different from those obtained with 20 trays used for absorption.

The feed gas to the treating unit contained from 1% to 2% CO_2 and from 5% to 6% H_2S during the tests. The outlet gas composition varied considerably, depending upon the operating conditions which were established. The relationship between acid gas concentration in the rich solution and percent of the acid gases which passed through the column unabsorbed is clearly illustrated in *Fig. 2*. Curves are presented for absorption with 8, 12, and 20 trays.

The acid gas concentration in the rich solution was increased in each series by decreasing the solution rate. As can be seen, this caused an increasing amount of CO_2 and H_2S to pass through the column unabsorbed. The use of the larger number of trays had the effect of allowing considerably more acid gas to be absorbed per unit volume of solution with the same absorption efficiency. For example, to pass 60% of the CO_2 under the conditions of this operation, the rich solution would contain on the order of 0.4, 0.6, and 0.8 mols of acid gas per mol of MEA for 8, 12, and 20 trays respectively. If the plant were operated in this manner, the H_2S absorption efficiency would be greatest for the 12-tray column.

In general, it can be said that the use of 20 trays results in the production of the purest gas with regard to H_2S and requires the least solution for a given treating job. The use of 12 trays permits operation with the greatest selectivity, and the use of 8 trays permits the greatest proportion of the CO_2 to pass through the column unabsorbed, but is correspondingly ineffective for H_2S absorption.

The selectivity of the operation is demonstrated in a simpler manner in *Fig. 3*, which shows the percent of H_2S passed versus the percent of CO_2 passed by the absorption column. The line at the top represents zero selectivity (equal quantities of both H_2S and CO_2 passed). The steeper the curve is on this chart, the more selective is the operation. The

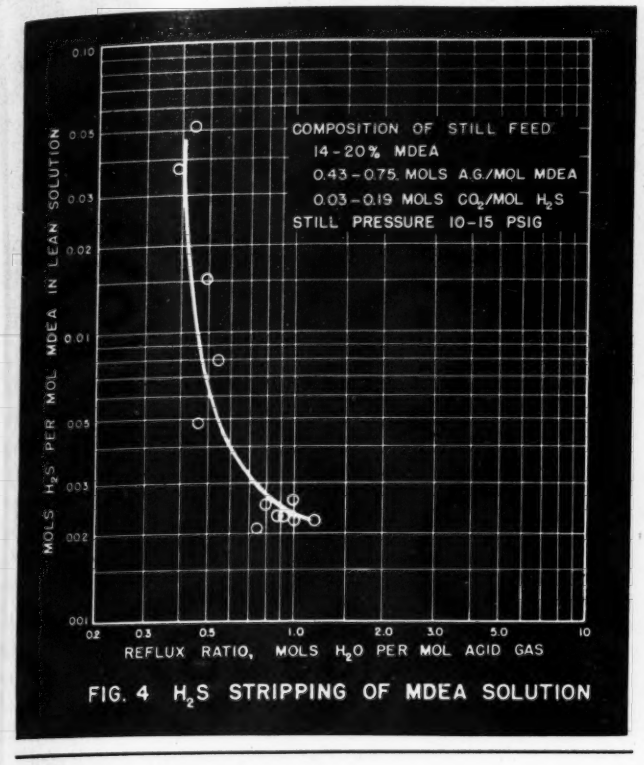

COMPOSITION OF STILL FEED
14 - 20% MDEA
0.43 - 0.75 MOLS A.G./MOL MDEA
0.03 - 0.19 MOLS CO_2/MOL H_2S
STILL PRESSURE 10-15 PSIG
MOLS H_2S PER MOL MDEA IN LEAN SOLUTION
REFLUX RATIO, MOLS H_2O PER MOL ACID GAS

FIG. 4 H_2S STRIPPING OF MDEA SOLUTION

RUN	PRESSURE PSIG	SOLUTION COMPOSITION % MDEA	% DEG	INLET GAS % H_2S	% CO_2	OUTLET GAS H_2S gr/100 SCF	% CO_2	ACID GAS IN RICH SOLUTION MOLS/MOL MDEA	% RECOVERY H_2S	CO_2
1	50	37	0	0.34	35.5	0.05	25.5	0.23	99.9+	38
2	45	32	0	5.0	25.0	0.5	19.5	0.30	99.9+	32
3	57	34	0	5.2	1.7	35	0.9	0.27	99.0	50
4	198	38	0	4.4	1.8	15	0.8	0.40	99.4	59
5	208	21	42	4.2	1.9	51	1.2	0.26	98.1	41
6	750	20	70	1.1	14.6	0.1	5.5	0.35	99.9+	66

CONTACTOR 4" I.D.; PACKED WITH 11' OF 3/8" RINGS.

TABLE III - TYPICAL PILOT PLANT DATA

LOCATION	TEMP. °F	INCHES PENETRATION PER YEAR STEEL	5% CROLOY	304 STEEL	3S ALUMINUM
		(x 10^{-4})	(x 10^{-4})	(x 10^{-4})	(x 10^{-4})
REBOILER	255	70	31	0	12
HEAT EXCHANGER LEAN SOLUTION SIDE	240	51	28	0	12
HEAT EXCHANGER RICH SOLUTION SIDE	150	28	11	0	187
CONTACTOR 20th TRAY	95	5	5	0	4

TABLE II - CORROSION OF METAL COUPONS AT VARIOUS POINTS IN PLANT USING MDEA

points shown, which are for the commercial column operation, are quite widely scattered, as they represent operations with various numbers of trays and under widely varied operating conditions. The solid line represents the average of the points.

For purposes of comparison, a line is also included which represents the average of pilot plant operations under conditions somewhat similar to those of the commercial unit. This pilot plant series was not strictly comparable, however, as a more concentrated MDEA solution was used, and a somewhat higher pressure was maintained.

The bottom line, which illustrates the most selective series of pilot plant runs, has been included to illustrate the degree of selectivity obtainable with MDEA solutions under ideal conditions. This series of runs was conducted at a lower pressure (50 psig) which improved selectivity, and at a very high ratio of CO_2 to H_2S in the feed gas. The line for the commercial column indicates that under the condition of this operation, half of the CO_2 can be passed through the column unabsorbed while passing only 1% of the H_2S; two-thirds of the CO_2 can be passed while passing 5% of the H_2S; and three-fourths of the CO_2 can be passed when passing 10% of the H_2S.

The temperature of the lean solution feed to the absorber varied from 90° to 100°F during most of the tests; however, the investigation covered the range of 84° to 109°F. The data indicated that in general the selectivity was improved somewhat by decreased temperature. As would be expected, increasing the temperature causes the solution capacity to fall off rapidly.

Solution regeneration

Our experience with MDEA solutions indicates that they are readily stripped of acid gases. *Fig. 4* presents some stripping data on MDEA obtained in the commercial plant still. In this chart, hydrogen sulfide concentration in the lean solution is plotted against the still reflux ratio. The reflux ratio represents the mols of water returned to the top of the stripping column per mol of acid gas stripped. In a system such as this, where essentially no water is added or removed from the solution during operation, the still reflux is a measure of the available stripping vapor in the column. The steam load for regeneration is determined from the heat requirements to provide the heat of reaction, sensible heat and reflux.

As shown on the chart, stripping efficiency became quite low below a reflux ratio of 0.5, but at a ratio of 0.8 to 1.0, the hydrogen sulfide content of the lean solution leveled out at about 0.0025 mol H_2S per mol of MDEA. The CO_2 concentration in the lean solution during all of these runs was found to be very low (1/10 to 1/5 of the H_2S concentration). Since the rich solution to the still contained from 0.4 to 0.8 mol of acid gas per mol of MDEA, it is apparent that more than 99% of the acid gas was removed from the solution in the stripping column. A reflux ratio of 1 mol H_2O per mol of acid gas stripped in this particular treating plant represented a steam consumption of approximately 2 lbs of steam per pound of acid gas. This is comparable to steam consumption figures available for typical DEA units. Aqueous solutions of MEA normally require somewhat higher steam rates, particularly if it is necessary to strip CO_2 from the solution.

In normal treating operations, the product gas purity is a function of the H_2S concentration in the lean solution. No attempt was made to determine the maximum gas purity obtainable in this plant with the lean MDEA solution produced. However, treated gas containing as low as 2 grains of H_2S per 100 scf was produced on occasions. During pilot plant studies with this amine, it was found possible to produce lead acetate sweet gas (less than ¼ gain per 100 scf) at a comparable contactor pressure.

Corrosion

The plant was shut down and inspected for corrosion after about 20 weeks of operation with MDEA. No major evi-

RUN	NO. OF TRAYS	INLET GAS		OUTLET GAS		ACID GAS IN RICH SOLUTION MOLS/MOL MDEA	% RECOVERY	
		% H_2S	% CO_2	H_2S gr/100 SCF	% CO_2		H_2S	CO_2
1	8	5.3	1.2	384	0.9	0.43	90	25
2	8	5.2	1.3	710	1.1	0.55	79	17
3	12	5.4	1.4	98	0.8	0.57	97	44
4	12	5.4	2.0	333	1.5	0.69	91	29
5	20	5.1	1.2	5	0.4	0.57	99.8	68
6	20	5.2	1.3	333	0.7	0.75	92	49

MDEA CONTENT OF SOLUTION 18 - 19%. FEED GAS RATE 3000 - 4500 MSCFD.
SOLUTION RATE 27 - 48 GPM.

TABLE I - TYPICAL PLANT OPERATING DATA

dence of corrosion could be detected, although there were some slight indications that corrosion had taken place in the reboiler and on the lean solution side of the heat exchanger. Corrosion of the test coupons which had been installed at the start of the MDEA test was generally very low, as shown in *Table 2,* which shows the corrosion of the various materials in inches penetration per year as calculated from the weight loss during the 20-week period.

The most severe corrosion of steel, to the extent of 0.0070 in. penetration per year, occurred in the reboiler; however, this rate is considered to be quite low and no more serious than that normally encountered in DEA and MEA treating plants. The 3-S aluminum coupons showed only slight or mild corrosion except on the sample located in the rich solution inlet side of the heat exchanger. This coupon showed a corrosion rate of nearly 0.02 in. per year, which could be considered serious, particularly since pitting was observed. The Croloy 5 coupons appeared to be slightly more resistant than carbon steel. The Type 304 stainless coupons showed no detectable corrosion.

The corrosion tests in this plant substantiated previous laboratory tests which had shown MDEA-acid gas-water systems to be no more corrosive than the comparable systems involving MEA and DEA. The dynamic-corrosion test apparatus used for this work has been described by Riesenfeld and Blohm.[8] On the basis of both the laboratory data and commercial plant tests, it appears that mild steel is a satisfactory construction material.

Comparison with other data

Triethanolamine (TEA) has also been proposed as a selective absorbent for H_2S in the presence of CO_2. The results of a pilot plant comparison of DEA and TEA have recently been published by the Bureau of Mines.[9] They found that for a given treating job where DEA removed about 63% of the CO_2, TEA removed only 36% of this component. In a previous publication of the Flour Research Division,[7] a pilot plant comparison of TEA and MDEA is presented. It was found that the MDEA solution produced considerably purer gas with regard to H_2S and absorbed more acid gas per unit volume of solution based upon systems of equivalent normality.

Typical pilot plant operating data for MDEA solutions are presented in *Table 3.* The pilot plant used for these studies has a 4-in. ID contactor packed with 11 ft of ⅜-in. rings. The still is made of 6-in. pipe and contains about 7 ft of packing with the liquid feed point approximately 3 ft from the top. A great number of runs has been made with MDEA solutions in this unit, and these six examples were chosen as they illustrate the effects of widely varying conditions.

Runs 1, 2, and 3 represent operation at low pressure with approximately 35% aqueous MDEA solution. In Runs 1 and 2, the amount of CO_2 in the feed gas was considerably greater than the amount of H_2S, and it will be noted that only about one-third of the CO_2 was absorbed while more than 99.9% of the H_2S was removed from the gas. In the third run, more H_2S than CO_2 was present in the gas stream, and the selectivity of H_2S decreased appreciably. Run 4 was made with the same solution and feed gas as Run 3, except that the contactor pressure approximated 200 psig. It will be noted that the main effect of this increased pressure was to increase the quantity of acid gas absorbed per mol of MDEA. Runs 5 and 6 were conducted with a solution which contained diethylene glycol (DEG) with approximately 20% MDEA. In Run 5, at 200 lbs, it is seen that good selectivity was obtained, while in Run 6 at 750 lbs, 66% of the CO_2 was absorbed. It will be noted, however, that in this last run an outlet gas containing only 0.10 grain of H_2S per 100 scf was obtained.

Solution deterioration

The refinery test of MDEA was greatly complicated by the presence of contaminants other than H_2S and CO_2 in the refinery gas. Inventory studies showed a considerable loss of amine during the period of operation, and titration of the reflux with acid seemed to indicate the presence of amine. After a considerable amount of searching, it developed that the apparent amine in the reflux was actually ammonia brought in with the gas, and in addition to the ammonia, the gas contained other contaminants, presumably hydrogen cyanide and organic acids, which reacted with the MDEA forming thermally stable compounds. Subsequent anaylses of the DEA which had been in the plant prior to the test showed that it too had been partially deactivated.

Upon completion of the test with MDEA, the plant has been gradually returned to a DEA system by the use of DEA makeup. To minimize solution contamination, a water wash has been installed ahead of the treating unit, and according to latest reports, it is a very satisfactory job in preventing any additional contaminating material from entering the treating plant solution. The principal reason for returning to DEA operation on this unit was the comparatively high cost of MDEA, 77½ cents per lb, as compared with 31¼ cents per lb for DEA. According to the manufacturer, if commercial application of this amine gains wide acceptance, the price will be reduced appreciably.

Acknowledgment

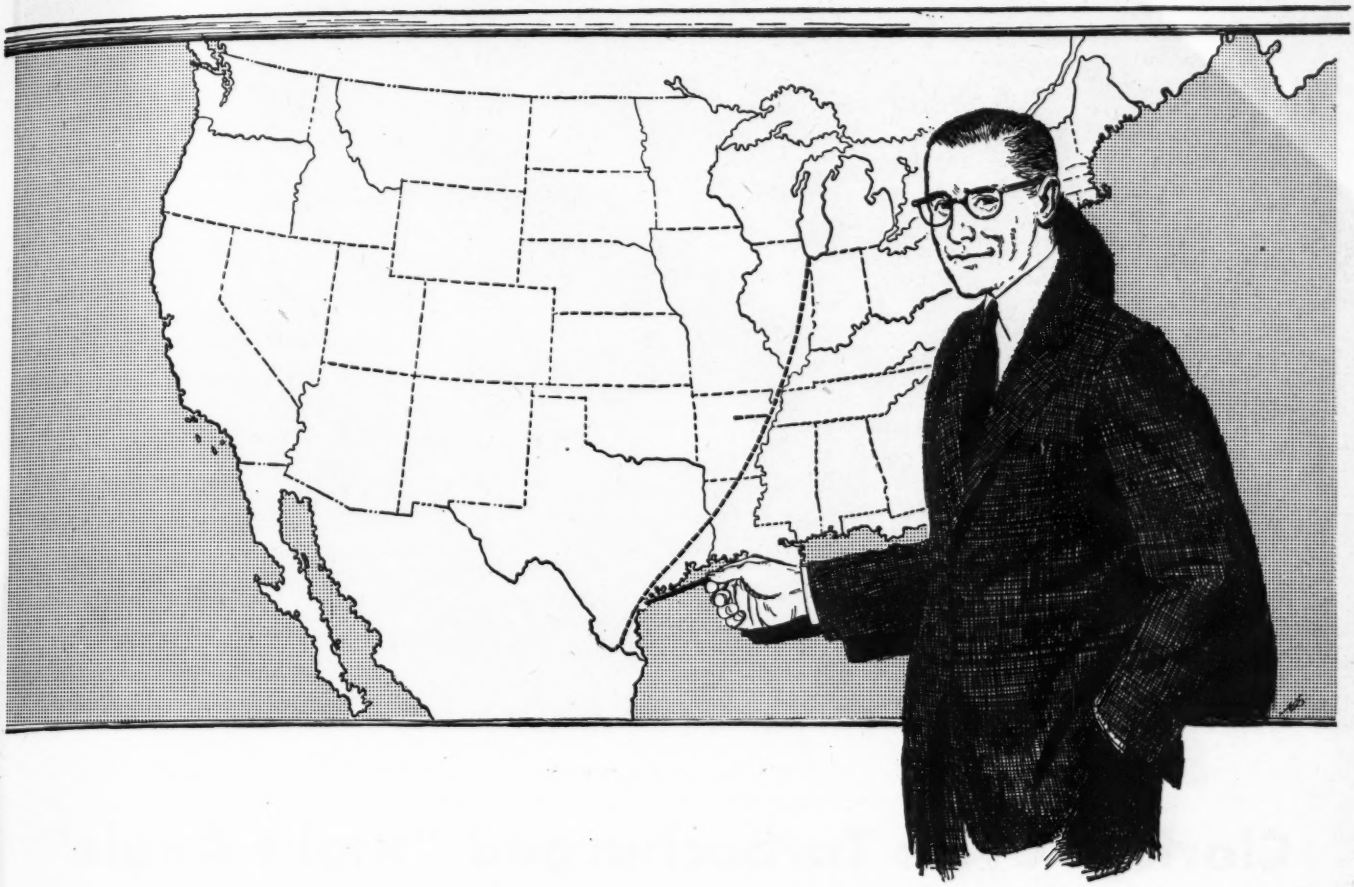
The authors wish to express their appreciation to the operating staff of the Wilshire Oil Co. for their cooperation during the test, and to the managements of the Wilshire Oil Co. and the Fluor Corp. for permitting publication of the data.

References

[1]Bottoms, R. R., U. S. Patent 1,783,901 (1930) RE 18958 (1933)
[2]Reed, R. M. and Wood, W. R., Trans. Amer. Inst. Chem. Engr. *37,* 363-84 (1941)
[3]Hutchinson, A. J. L., U. S. Patent 2,177,068 (1939)
[4]Blohm, C. L., and Chapin, W. C., Calif. Oil World, 2nd Issue *41,* 12 (June 1948)
[5]Atcheson, Mack and Cohn, A. A., World Oil, 297-300 (Oct. 1952)
[6]Frazier, H. D. and Kohl, A. L., Ind. Eng. Chem. *42,* 2288-2292 (Nov. 1950)
[7]Kohl, A. L., Pet. Proc., *6,* No. 1, 26-31, (Jan. 1951)
[8]Riesenfeld, F. C. and Blohm, C. L., Pet. Ref., *29,* No. 4, 141 (April 1950)
[9]Wainwright, H. W., Egleson, G. C., Brock, C. M., Fisher, J., and Sands, A. E., Bureau of Mines, Report of Investigations 4891 (Oct. 1952)

This article is adapted from a paper presented at the PCGA technical services conference, Feb. 18-19, in Los Angeles.

RIGHT AT THE BEGINNING—



Plan on using Bitumastic® Enamel to protect your pipe line against corrosion

ANY pipe line, whether large or small, is an important investment — an investment that should be properly protected.

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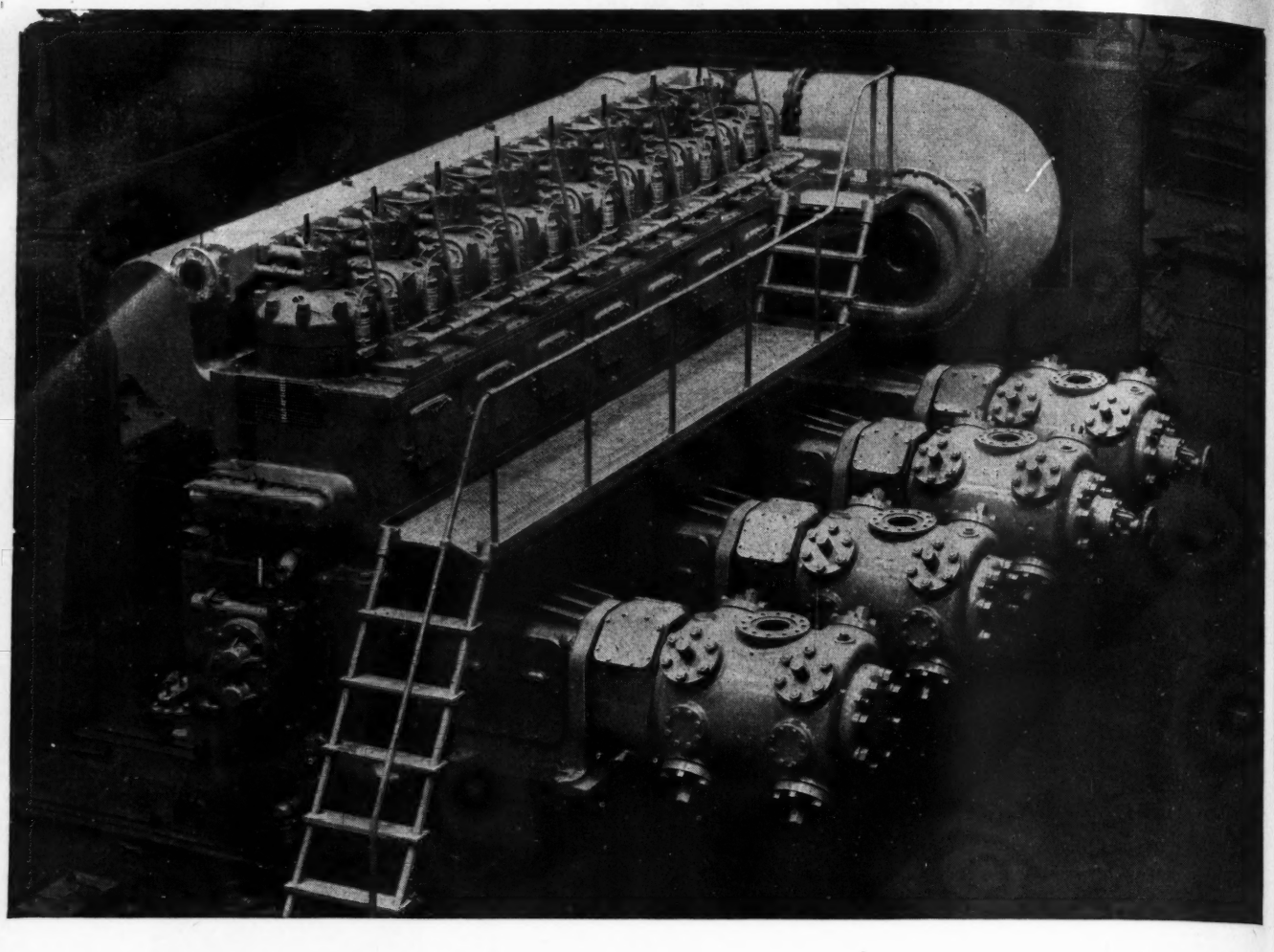


Clark 2-Cycle Turbocharged "Right Angle" Heralded As Most Significant Development In Compressor History

Revolutionary changes in gas-engine-driven compressor design set new records for power (50% increase), fuel economy (10-15% decrease) and cooling water load (25% decrease)

THE recently developed Clark 2-Cycle Turbocharged Right Angle Compressor has set new, industry-wide standards for power and operating economies, reports Clark Bros. Co., Olean, N. Y.

Climaxing an intensive 7-year Clark development program, the availability today of this completely new, turbocharged compressor design provides the realistic and ready answer to increasing cost of gas, inadequate cooling water supply in certain areas and the need for more powerful, more compact units. Clark engineers list the following points in support of these claims:

50% More Power

Fifty percent (50%) more power is delivered than by any previously built non-turbocharged unit of comparable bore and stroke (without any encroachment on overload carrying ability). The stepped-up power output means reduced building, foundation, piping and maintenance costs as well as decreased operating personnel.

10-15% Less Fuel Consumed

Conservatively rated, the new Clark unit is guaranteed to burn 10 to 15% less fuel than the best non-turbocharged, high compression, gas-engine-driven compressor previously built.

25% Less Cooling Water Load

Cooling water requirements per bhp are twenty-five percent (25%) less than those of the best non-turbocharged, high compression, gas-engine compressor previously built (including scavenging air

intercooling duty). This is important not only in arid locations, but means fewer cooling towers, smaller pumps, smaller piping and smaller motors to drive water pumps.

Flat Fuel Consumption Curve

Fuel consumption remains practically constant between seventy percent (70%) of load and maximum load, assuring optimum fuel economy over the entire operating range.

Quiet Operation

Energy, formerly lost in noise, is now harnessed for useful work by the Clark Turbocharger. This, plus a fully insulated exhaust manifold and en bloc construction, make it the quietest, smoothest operating gas-engine-driven compressor ever built. There are no exhaust pulsations.

UNITIZED, MATCHED DESIGN

Both turbocharger and compressor were designed and built by Clark as matching components. The result, say Clark engineers, is a highly efficient, unitized and integrated design.

The Turbocharger

The Clark turbocharger combines many of the design principles of Clark radial inflow turbines, combustion gas turbines and centrifugal compressors.

As applied to the new Clark Compressor, turbocharging is a practical means of converting waste heat into energy. It utilizes the waste heat, velocity and mass flow of the exhaust gases to drive a radial inflow turbine. The turbine, in turn, is integrally connected to a centrifugal compressor impellor which pumps air to scavenge the power cylinders and to furnish air for combustion. No scavenging cylinders are used or required.

At start-up and on light loads, the turbocharger is direct driven through a gear train from the engine crankshaft. Under all other load conditions, the turbocharger operates independently of the engine, its speed automatically conforming to the load placed on the engine.

Because the Clark turbocharger operates at very conservative speeds and temperatures, no critical, scarce materials are required for its construction.

The Compressor

While the gas-engine-driven compressor is an entirely new unit, specially designed to match the characteristics of the new Clark turbocharger, it retains many of the basic Clark "Angle" design features. Clark engineers describe it as the most rugged compressor ever built, "with a very conservative BMEP rating for a unit of its proportions."

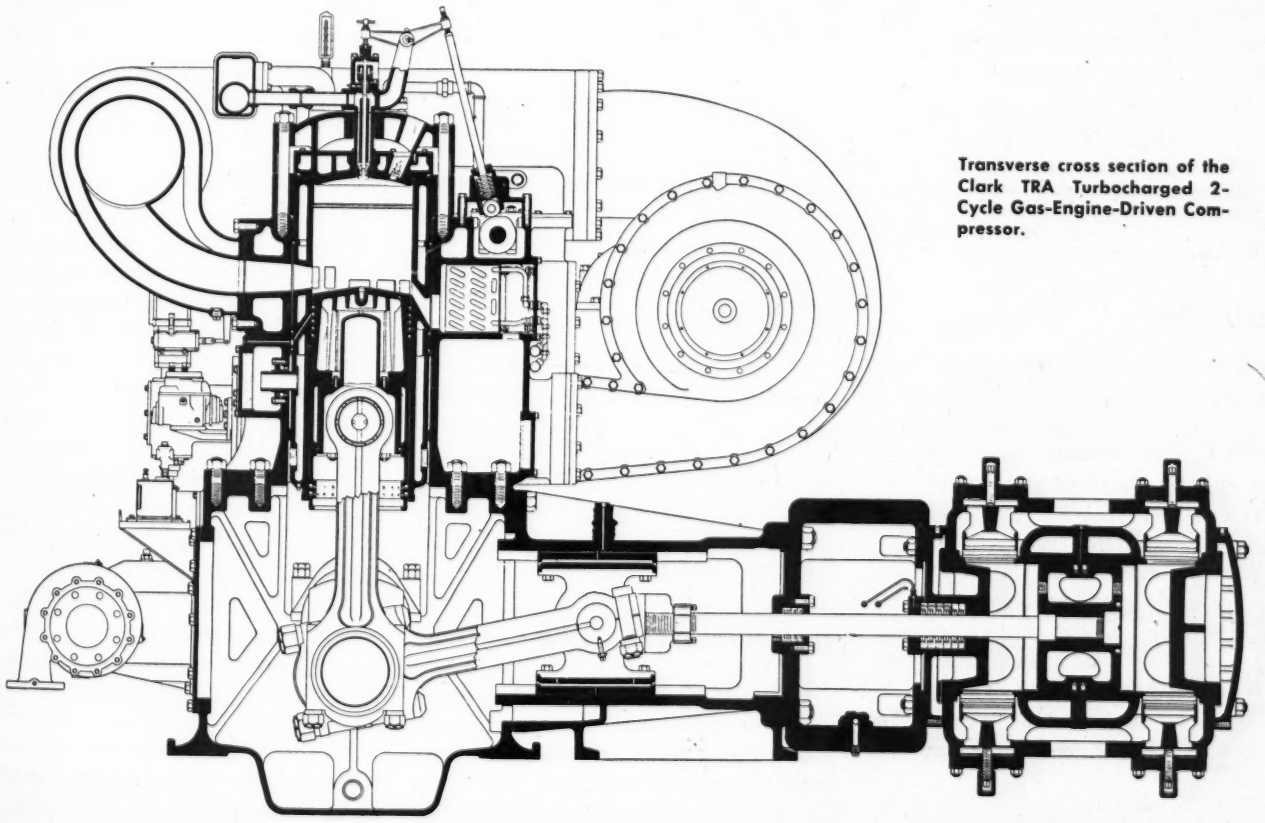
Following a long established Clark practice, the new compressor is an extremely compact, yet highly accessible 2-cycle, in-line design. It occupies considerably less space per bhp than non-turbo-charged units, because of its increased power output. Featured are: Cylinder block construction with removable power cylinder liners; full precision bearings; one-piece forged steel crankshaft; oil-cooled power piston heads and skirts; heavy, forged steel connecting rods; fully insulated, streamlined exhaust system.

MODELS

The Clark Model TRA-8, illustrated, has eight vertical in-line power cylinders of 14″ bore and 14″ stroke, developing 1320 bhp. Other size turbocharged units also are available.

Bulletin 130, with complete information on the Clark 2-Cycle Turbocharged Gas-Engine-Driven Compressor is obtainable from Clark Bros. Co., Division of Dresser Operations, Inc., Olean, N. Y.

Clark manufactures a complete line of heavy duty compressors: motor driven; gas, steam and Diesel engine driven; centrifugal and axial flow.



Transverse cross section of the Clark TRA Turbocharged 2-Cycle Gas-Engine-Driven Compressor.

Pipeline cracking tests begun in Ohio

TESTS to develop information on high speed cracking of large-diameter, high-pressure gas transmission lines are getting under way this month near Athens, Ohio. Under the direction of C. F. de Mey, vice president and chief engineer of the Columbia Gas System Service Corp., the tests are being conducted in an effort to work out a solution to the critical problem in connection with the revision of the ASA Code for Pressure Piping.

The tests will be conducted on property owned by the Texas Eastern Transmission Corp., six miles south of Athens.

The testing program is sponsored by the American Gas Assn. With laboratory work, it is estimated the cost to participating industries will be over $100,000.

The research involves subjecting pipe of various diameters to pressures normally used in transmitting natural gas over long distances. The pipe will be damaged and "notched" purposely, prior to the tests, to cause it to fracture under these pressures.*

Since the type of crack in pipe is indicated by the speed at which the crack develops, intricate measuring devices will clock the speed of the break as it travels along the pipe.

100-yard line

An experimental pipeline, about 100 yards long, is being laid in the ground. The line will be built in three sections. Only the center section—about 30 feet long—will be fractured during the experiments.

Mr. de Mey stated that the current experiments stem from the desire of engineers and metallurgists to expand their knowledge on the subject and develop more detailed information on which to base engineering calculations.

It is hoped that most of the group's research will be done on a laboratory scale at much less expense than in the field, Mr. de Mey said. The field work will be used as a check against the laboratory work. If there is a true relationship between the two, tests then can be made in the laboratory in the future.

C. F. de Mey, vice president of Columbia Gas System Service Corp., is in charge of the Athens tests to obtain data on high-speed cracking of pipelines.

Staff members of the Battelle Memorial Institute of Columbus will conduct the field and its associated laboratory work.

Present plans call for eight field tests on 20- and 30-in. pipe at various temperatures. The tests will be run a few weeks apart.

The engineers will create their own refrigeration system when a low temperature test is made. Before each line is ruptured, it will be surrounded by large quantities of dry ice. Household-type electric fans will circulate the cool air and permit control of temperatures to within 5°F.

Measuring crack's speed

To measure the speed at which the crack travels, fine wires will be cemented around the pipe's circumference at accurately measured distances. The wires will be connected to an electronic timing device. The crack, as it extends along the pipe, will break the wires, causing the time to be recorded when the wires break. From those times, the engineers can figure the velocity of the crack.

Other devices will be connected to the pipe to measure temperature and stress.

The group Mr. de Mey heads is the "Line Pipe Field and Laboratory Research Committee." It is a part of a subcommittee on natural gas transmission and distribution which was formed within the American Standards Assn. to develop a national standardized code for pressure piping.

Administrative work of forming the code within the ASA is being supervised by the American Society of Mechanical Engineers.

Who's in charge

In addition to Mr. de Mey, members of the group in charge of the Athens tests are B. D. Goodrich, vice president and chief engineer of Texas Eastern; Earl Smith, chief metallurgist of Republic Steel Co., Cleveland; and Arthur Wilder, chief metallurgist of the National Tube Division, U. S. Steel, Pittsburgh.

Consultants to the group are Lloyd Jackson, assistant director of Battelle, Harry Udin, assistant professor of metallurgy, MIT, and E. C. Wright, professor of metallurgical engineering, University of Alabama.

Although the natural gas industry initiated the idea of revising the national code and has been the principal force behind it, related industries and organizations, including pipe manufacturers, regulatory bodies, and other groups, are taking major parts in the program.

Cost of the pipe fracture tests and laboratory work is being split among the steel industry, natural gas pipeline industry, and natural gas utility companies.

Mr. de Mey said that in conjunction with the pipe fracture tests, the group plans to experiment on the related subject of secondary stresses.

*For further information on high-speed cracking and investigation of notch failures, see the *GAS* report on Fred Hough's speech at the 1953 AGA transmission conference (*GAS*, June 1953, page 92).

Protective coatings:

A sound "insurance policy" for pipe protection

Adequate insurance (with a one-shot premium) is necessary to protect heavy pipeline investments. The author, a strong advocate of cold-applied coatings, presents arguments for his favorite materials and techniques for applying them.

By **WAYNE H. SCHULTZ** • Dearborn Chemical Co., Chicago

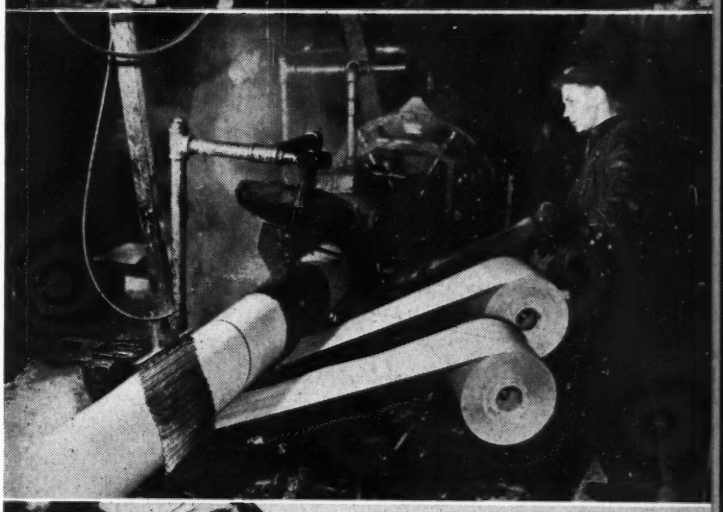
A GENERAL consensus on the use of protective coatings is that where an excellent soil condition exists and experience has proven the life of bare pipe to be over 25 years, the expenditure for coating and wrapping should be nil. However, there should be some variance in such opinions, due to ever-changing soil conditions and even where an initial soil survey shows no need for protection, some means of protection should be considered to combat soil or surface conditions. Let's look into several phases of pipeline investment insurance.

Reconditioning loaded lines

There are many cases where pipelines were originally laid bare and, upon inspection at a later date, were found to have been attacked by corrosion. The installation of cathodic protection to a bare pipeline is not the economical way to handle such a problem. In most cases, if the capacity of a line is sufficient for load requirements, it is more economical to recondition the line in place than to replace it later with a new coated and wrapped steel pipeline.

An expedient way to recondition a line in service is to expose the line in the trench by use of a backhoe, or ditching machine, being careful not to break the line. The service connections on a distribution main can be cut off and a rubber hose connection substituted to allow for flexibility. The line can then be raised a distance of from 12 in. to 16 in. from the bottom of the trench, so that a traveling type cleaning machine can be put on the line. After such superficial cleaning, the pitted areas should be cleaned with an electric drill with wire cup brush attachment. Any pits that are

Over-the-ditch application of coating includes the use of primer, wax-type coating, spiral felt wrap.



For mill coating and wrapping, or rail-head operations, additional coating goes over wrapper, followed by kraft paper wrap.

Where terrain is too steep or rugged, cold-applied coating and wrapper combination is used.

GAS exclusive

beyond 40% depth of the pipe wall thickness are then pit welded. Where small holes appear, they are plugged and welded over. Larger holes are covered with an asbestos gasket over which a steel leak clamp, or contoured steel plate, is clamped, and the clamp or plate is then welded in place. Half-sole plates are welded on areas where pits are concentrated. If a section of pipe is badly pitted, the gas supply can be bypassed through a small line while a new pipe section is being installed.

After thorough inspection of the pipe surface and welded connections, it is recommended that the pipe be primed with a cutback, cold applied, non-oxidizing, chemically compounded rust preventive primer, which acts as a special wetting agent to prepare the pipe surface for coating application. This is particularly necessary on reconditioned pipe where the surface is rough and pitted. After the primer has dried sufficiently, a cold applied, non-oxidizing, pliable coating plastic in nature and containing active rust inhibitors, is rubbed into and over the pipe surface to a thickness of 1/32 in. to 1/16 in. A spiral wrapping of an impregnated and coated fabric or glass mesh laminated to a non-fibrous plastic membrane is then applied over the coating with the shielding membrane on the inside. To insure tight wrapper laps, a cold film application of a heavy pigmented, non-oxidizing coating is recommended over the wrapper.

Being cold applied, this type of protection eliminates any fire hazards around the "loaded" line, and affords long-lasting pipe protection. All of this can be done without taking the line out of service. After the line is lowered and services replaced, and the trench is backfilled, the pipeline owner is assured of uninterrupted service.

New pipeline installations

For new pipeline installations, the coating and wrapping can be applied by competent mill applicators, at rail-head plants, or over-the-ditch.

There are many specifications to choose from, usually contingent upon soil conditions to be encountered.

In choosing a coating and wrapping combination, there are many factors to be considered. The coating must have the following characteristics: be easy to apply, have good bonding qualities, and be resistant to water penetration, chemicals, soil stress, freezing (cold flow and cracking), bacteria and vegetation; it must have dielectric strength, permanence, and above all, low porosity. Few coatings today meet all these desired characteristics.

All pipeline coatings are only as good as their accompanying reinforcement or wrappers, and here too, the wrappers or reinforcement must have the following desirable characteristics: the wrappers must have shielding qualities and possess high dielectric strength, resistance to water penetration, high elasticity, chemical inertness, mechanical strength (both with the grain and across the grain), and contain a high percentage of coating saturation.

The combined qualities of coating and wrapper are available today in the specification employing the use of a suitable primer, a high melting point micro-crystalline wax-type coating containing active rust inhibitors applied to a minimum thickness of 1/32 in., followed by a spiral wrapping of a micro-crystalline, wax-type saturated reinforced asbestos felt, with or without a lamination of a non-fibrous plastic membrane, which is applied next to the coating. The aforementioned is a typical over-the-ditch application.

For mill coating and wrapping, or rail-head operations, it is common practice to apply, when soil conditions so require it, an additional application of coating over the wrapper, followed by a wrapping of heavy kraft paper.

Coating over rough terrain

On cross country lines where the terrain is too steep and rough to allow operation of a traveling coating and wrapping machine, the application of the cold applied coating and wrapper combination is recommended as an expedient and economical means of protection.

Protection of field joints

An additional problem is the protection of the field joints of mill or rail-head coated and wrapped pipe. The solution to this problem is an easy-to-apply, economical coating and wrapping combination that can be applied cold, thereby not exposing the pipeline crew to burn hazards and toxic materials. This can be attained by using a cold applied non-oxidizing, pliable coating containing the best chemical corrosion inhibitors, plastic in nature, reinforced by a spiral wrap of an impregnated and coated fabric or glass mesh laminated to a non-fibrous plastic membrane, which is applied next to the coating. This wrapper is self-sealing, flexible and conformable to irregular surfaces, and has high dielectric strength, high moisture resistance, high tensile strength, and is resistant to attack by soil organisms. For added strength and shielding properties to the aforementioned coating and wrapping combination, a cold film application of a heavy, pigmented, non-oxidizing coating is recommended.

The coating and wrapping of welded and T&C field joints can be accomplished as mentioned above. However, for the coating and wrapping of mechanical couplings, the same materials are used but the procedure differs slightly. After the cold coating is applied generously to the body of the coupling, the bolts and follower rings, and the bare pipe at the sides of the coupling, it is recommended that a 4- to 6-in. wide strip of the saturated, reinforced, laminated wrapper be applied "cigarette fashion" around each follower ring, and then squeezed down over the ring edges and conformed over the bolt heads and bolt ends. Following this, a strip of the same wrapper, either 12 in., 18 in., or 36 in. wide, contingent on the size of the coupling involved, is then "cigarette" wrapped over the entire coupling, with a sealing lap of about 6 in. This wrapper is then squeezed down at the sides and conformed to the coupling and the pipe at the sides of the coupling. A film coat of the heavy, pigmented, non-oxidizing coating is then applied over the entire wrapped area.

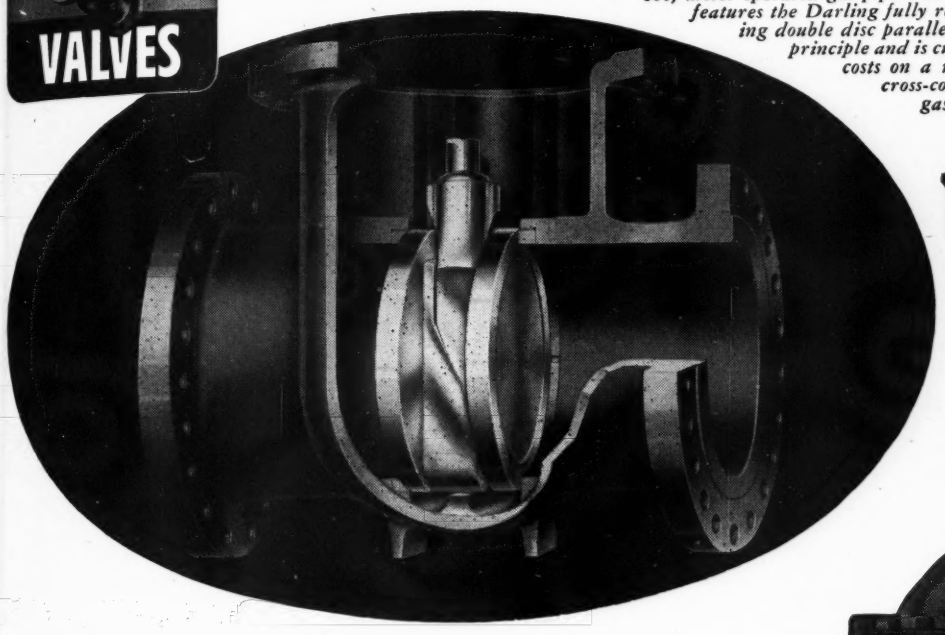
Protecting your investment

Thousands of miles of steel pipeline have been protected in this manner, with a history of many years of uninterrupted service, due completely to proper choice of pipeline insurance underwritten by quality coating and wrapping materials.

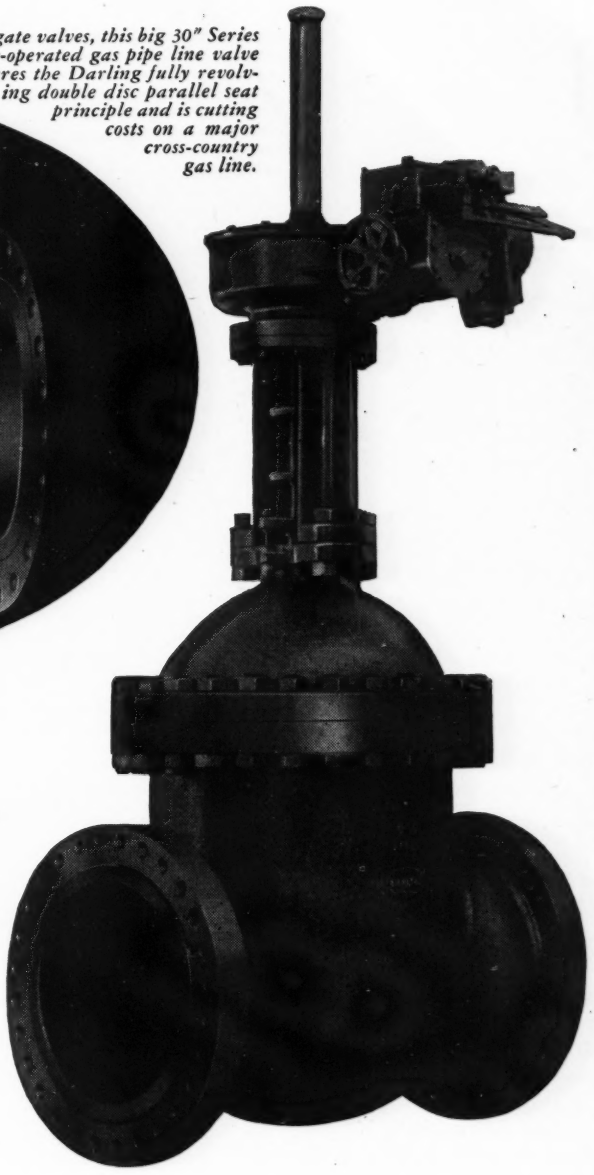
It is the ever-prevalent risk of costly destructive corrosion which justifiably directs the elimination of such chances by the adoption of a policy of "playing it safe." And to play it safe within the bounds of economic good sense, means to employ quality coating and wrapping on steel pipe wherever judgment or experience indicates a fair opportunity for return on the original investment. To be sure that there is an investment return, the only answer is insure now against the future by protecting costly steel pipeline installations with good quality coating and wrapping and cathodic protection. Engineers throughout the country concur wholeheartedly that such a combination is presently the ultimate in assuring long-life protection. This is your assurance, secured by pipeline insurance.

DARLING VALVES

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN



Like all Darling gate valves, this big 30" Series 600, motor-operated gas pipe line valve features the Darling fully revolving double disc parallel seat principle and is cutting costs on a major cross-country gas line.



IN NATURAL GAS TRANSMISSION LINES . . .

this Darling gate valve principle PAYS OFF!

TODAY you can avoid a lot of the costly, time-wasting valve trouble normally caused by temperature extremes and line stresses. Darling gate valves . . . *with their fully revolving double disc parallel seat principle* . . . are proving this on line after line.

This unique feature automatically compensates for valve body distortion, assuring *tight closure every time.* What's more, it means *uniform* distribution of disc and seat wear. The pay-off —less trouble, longer valve life, far less maintenance!

SEND FOR DATA

It will pay you to get better acquainted with Darling parallel seat gate valves. They come in a wide range of sizes and types for all gas and oil line requirements. Just outline your particular service needs or ask for a complete descriptive bulletin.

DARLING VALVE & MANUFACTURING CO.

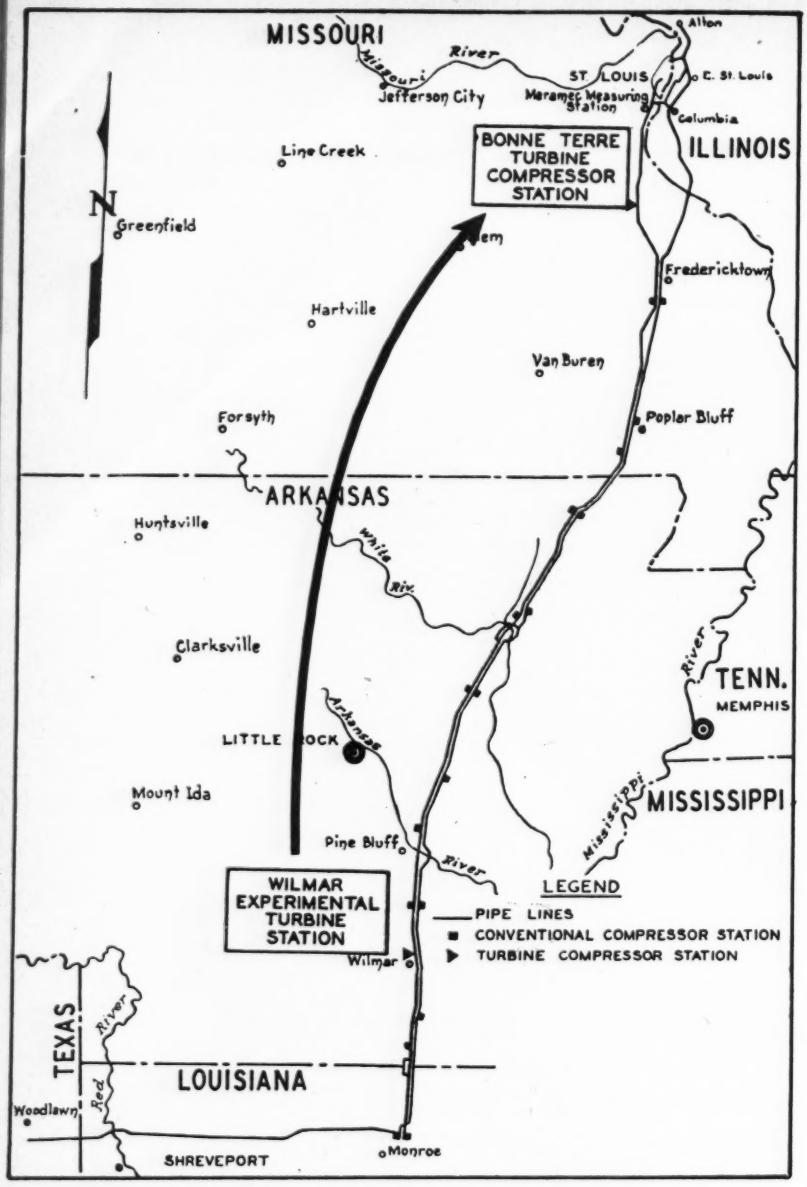
Williamsport 26, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

Field trials have yielded valuable operating data

Four years' operation with turbine-driven centrifugal compressors

By G. CARL COOPER JR.
Mississippi River Fuel Corp., St. Louis



After two years of operation at Wilmar, Ark., Mississippi's turbine-driven centrifugal compressor station was moved to Bonne Terre, Mo., near the market end of the pipeline.

Two more years have passed since the first report was made[1] on the testing of the 1850-hp simple cycle internal combustion gas turbine driven centrifugal compressor station which had been installed by Mississippi River Fuel Corp. in conjunction with the manufacturers.[2] Although, since that date, a number of more modern units with large turbines and using regenerative cycles of two-shaft turbine-compressor design have been installed, nevertheless what we have learned in the intervening two years using the turbine as an operational unit provides some new data and conclusions.

At the time of the earlier report, preliminary tests had been completed and curves had been developed that gave the ratings and characteristics of the turbine-compressor unit to the extent that they were then known. Since then, data have been compiled from which conclusions have been drawn concerning the practical field methods which may be used to check efficiencies of turbine and compressor.

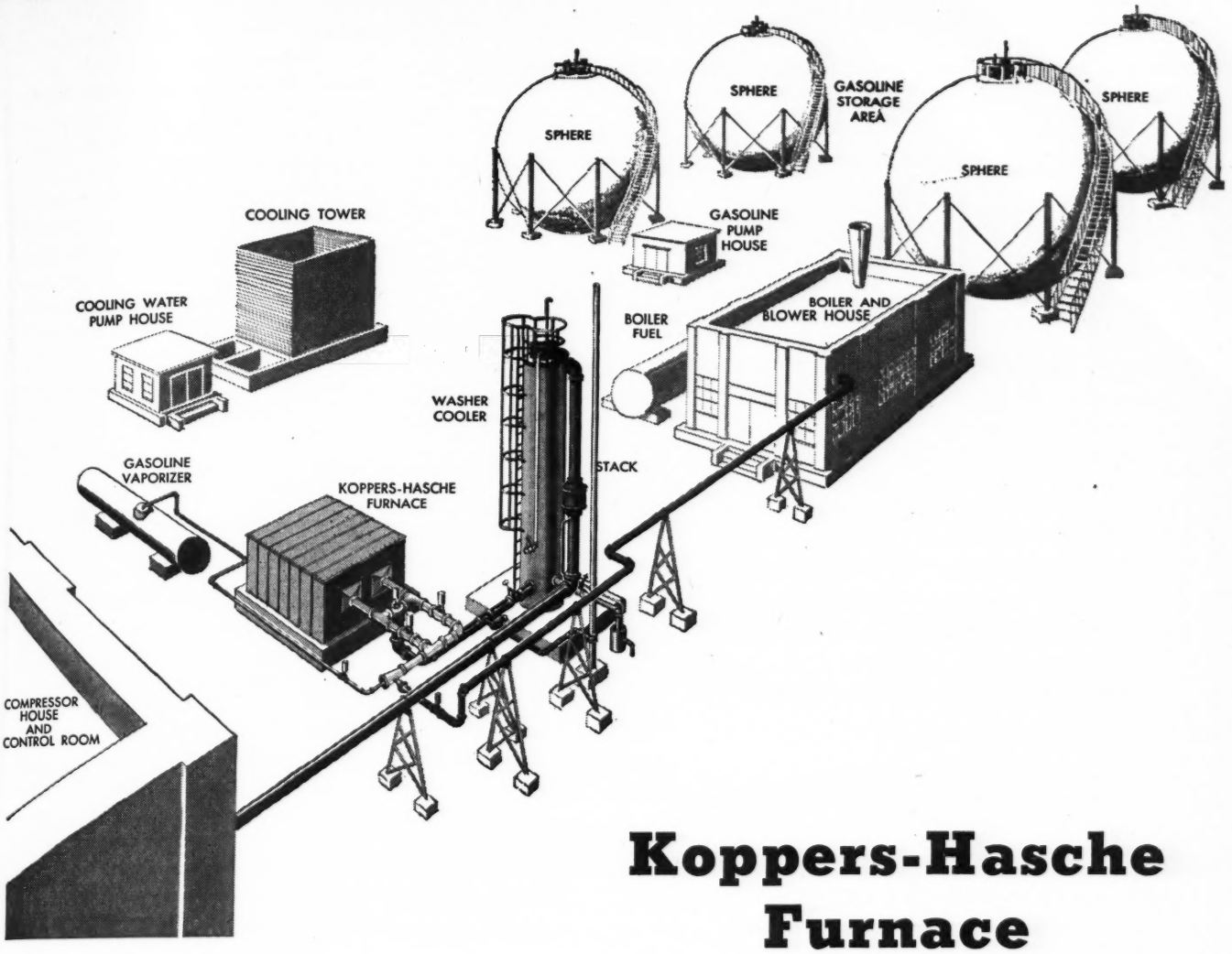
IN the spring of 1949 the turbine compressor unit was installed at Wilmar, Ark., as an experiment on the 425 psi transmission line of the Mississippi River Fuel Corp.'s system. At this location a line looping program that was then in progress provided an almost ideal combination of flow rate and pressures on the line to fully load the unit within the compression ratio available from the single impeller booster. The flow rate was to be high for several months. Since metering for the main line flow was installed, operation of the station block gate and discharge gate would permit any lower flow rate to be established for testing. Higher than line capacity flow rates could be established by recycling a portion of the gas through the block gate from the discharge back to the suction. Too high a raise in suction temperature was not desirable, so only a limited increase in flow rate above line capacity was tried.

Later in the looping program, when the second line was built past the station, sustained runs were made at the lower flows which resulted in the line on which the unit was in service.

In the fall of 1950 it was decided to move the turbine station to Bonne Terre, Mo., at the market end of the No. 1

1 Before the transmission section of the Southern Gas Assn. in its annual meeting at Biloxi. The current report was presented at the SGA convention in New Orleans, May 11-13.

2 Westinghouse Electric Corp. and Ingersoll-Rand Co. United Gas Corp. also participated. *GAS* published an article, "Lower Unit Costs Achieved in Gas Turbine Pumping Tests," on the Wilmar compressor in June 1952. J. O. Stephens of Westinghouse was the author.



Koppers-Hasche Furnace

solves your peak-load problems

THE Koppers-Hasche Reforming Process and Furnace are the result of 20 years of intensive experimental and development work. The Hasche Furnace is *unique in design,* being a thermal reforming process in which no free lampblack or carbon is produced. Gas is produced by passing a mixture of air and hydrocarbon feed stock continuously through a regenerative furnace.

The Hasche Furnace is invaluable in helping utility companies meet peak loads. Also, for industrial plants which use natural gas, as well as for utilities which distribute natural gas, this furnace is always ready to pinch hit in the event of temporary failure of the natural gas supply.

SOME PRINCIPAL FEATURES

Low Investment Cost

Extreme simplicity of process makes initial investment low compared to other types of production facilities. Savings are effected not only on furnace cost, but also on auxiliaries. Complete plant is compact, requiring relatively little ground space. Most of the equipment can be installed outdoors, saving cost of protective housing.

Low Operating Cost

Units are entirely automatic in operation, requiring minimum of operating labor and supervision. Few moving parts, thus reducing maintenance.

Low Pressure Fuel Storage

You are not limited to the use of propane with a Hasche Plant. Natural gasoline, readily available both winter and summer, is an ideal fuel to augment your natural gas supply.

For further information about the Koppers-Hasche Furnace, phone, write or wire.

KOPPERS

KOPPERS COMPANY, INC.

Engineering and Construction Division
Pittsburgh 19, Pennsylvania

TABLE 1. OPERATION OF BONNE TERRE STATION DURING 1951

	Hrs. Mins.	Remarks
With Oil Fuel		
January	69:10	Operated 1/19, 20, 24, 25, 26, 29*, 30*, 31* only.
February	28:10	Operated 2/1*, 2*, 7, 8, 14 only.
March	3:50	Operated 3/9 only (improved gas combustors installed).
With Gas Fuel		
April	6:10	Operated 4/1 only.
May	110:40	Began intermittent operation 5/7.
June	151:40	Discontinued operation 6/27.
July	236:22	Began intermittent operation 7/10.
August	389:05	
September	172:00	Operation intermittent 9/4 to 19, inclusive.
October	162:25	Began intermittent operation 10/8.
November	644:00	Began continuous operation 11/11.
December	716:45	
	2589:07	

*Date and mean temperature in St. Louis Area: 1/29, 3°; 1/30, 4°; 1/31, 8°; 2/1, 1°; 2/2, 11°.

TABLE 2. STATION DEPARTMENT SUMMARY OF AVERAGE OPERATING CONDITIONS
(Bonne Terre Station for Year 1951)

Fuel Oil Operation

Hours operated on fuel oil: 118.
Oil average heating value: 140,000 Btu/gal., 0.857 specific gravity.
Unit consumed approximately 200 gal./hr when delivering 1470 bhp.
Calculated thermal efficiency: 13.3%, .136 gal. oil/bhp hr.
Lube oil consumption approximately 1 gal./24 hr.
Rpm varied between 8000 and 8450.
Average combustor temperature: 1225° F (winter).

Natural Gas Operation

Hours operated on gas: 2581.
Gas average heating value: 1045 Btu/cu ft, .60 specific gravity.
Unit consumed 23.4 Mcf/hr when delivering 1540 bhp.
Calculated thermal efficiency: 16.0%, 15.19 cu ft gas/bhp hr.
Lube oil consumption approximately 1 gal./24 hr.
Rpm relatively constant at 8000.
Average combustor temperature: 1080-1100° F (winter).
Average combustor temperature: 1150-1200° F (summer).

TABLE 3. OPERATION OF BONNE TERRE STATION DURING 1952 WITH GAS FUEL

	Hrs. Mins.	Remarks
January	551:55	Continuous operation to 1/15, then intermittent.
February	316:35	Rotor failure occurred after 3228 hours operation—2918 hours "on the line." 2/23.
March	85:20	Repairs completed on rotor 3/23.
April	279:25	Intermittent operation.
May	214:35	
June	10:40	6/2 Turbine not required until Aug. 20.
July	None	
August	105:20	Began intermittent operation 8/20.
September	632:27	Began continuous operation 9/15.
October	714:12	
November	633:55	Off line 11/14, 15 and 16 to install new disc type rotor. 2237 hours on replaced rotor.
December	743:45	1071 hours on new rotor at year end.
	4288:09	

mainline. This end of the line operates at a discharge pressure of 425 lb. At Bonne Terre, it is utilized to increase the winter peak hourly flows and delivery pressures into Meramec measuring station adjacent to St. Louis, and in the summer to divert gas from the No. 2 mainline. During the summer of 1951, the increase in delivery pressure on the No. 2 line was utilized to enable delivery of gas without a field compressor to an experimental underground storage facility being tested.

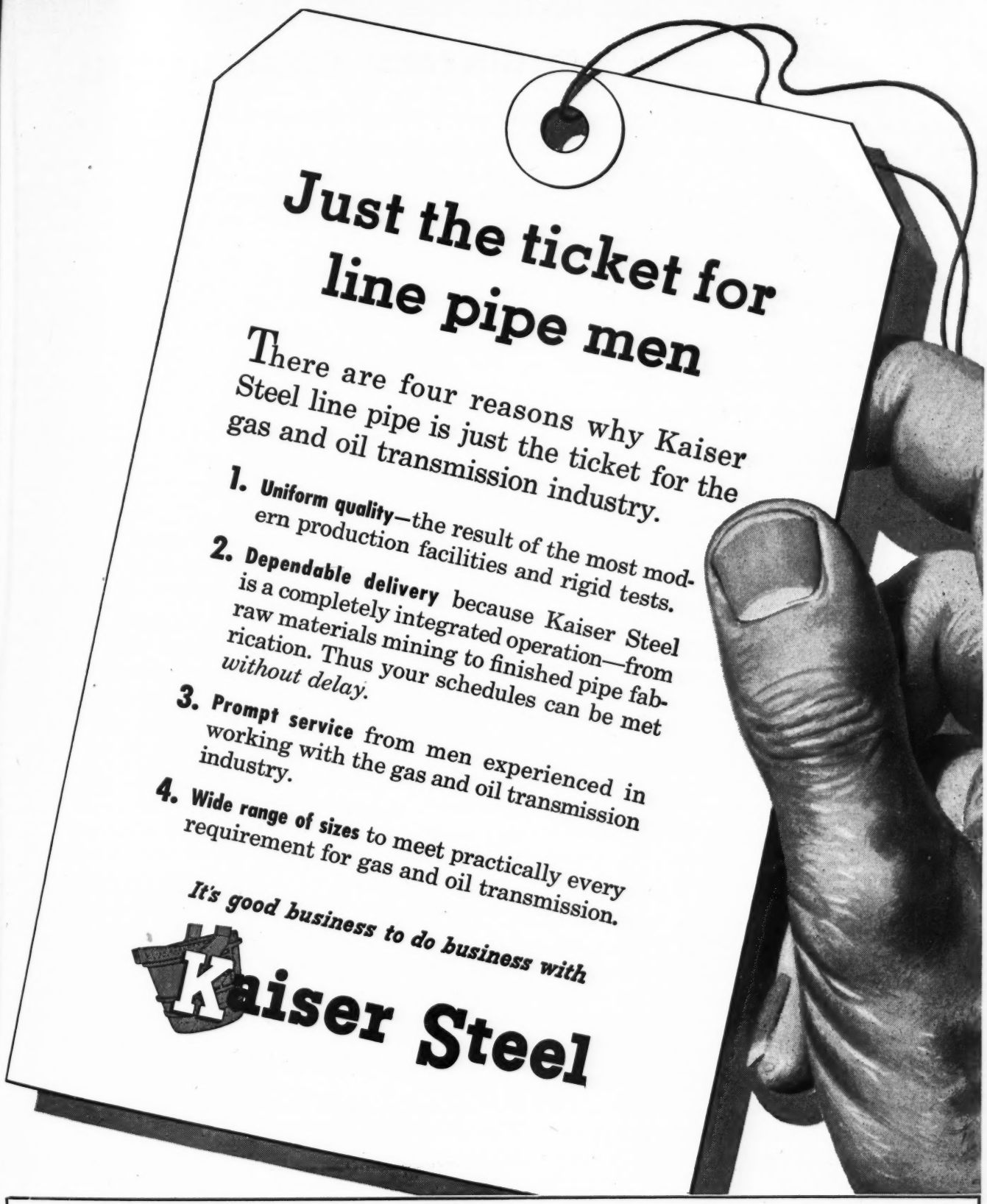
A number of improvements in design of the compressor station were incorporated in the permanent station. Gas piping, oil piping, electric wiring, and other facilities were revised and simplified. It was necessary to meter the main gas since the station is only a short distance from Meramec measuring station, where the output of mainline No. 1 is metered. Larger piping was installed between the main line and compressor to reduce the pressure drop through the station. Unfortunately, the station was urgently needed for the winter load. Lack of time to secure new equipment and modify the turbine necessitated the use of equipment and facilities from the experimental station, precluding the incorporation of some desirable features in the permanent station. Regular compressor station operators in charge of the station foreman were assigned to tours of duty here.

Oil for peaks

By Jan. 19, 1951, facilities to operate the turbine on oil were completed. Because of the great expense of the oil fuel it was used only when essential to deliver gas in peak hours and on days of high demand. New combustors of improved design to burn gas fuel were installed March 9, 1951, and on May 1, 1951 the turbine station was placed in regular pipeline operation to serve as the dispatching required.

Table 1 summarizes details of the "Operation of Bonne Terre Station During 1951." The hours of operation with oil fuel to serve the load on peak days and to move the line pack during peak hours are shown at the top of the table. A freak cold front that struck the station on Feb. 1 brought a —22° temperature when the turbine was started up that morning, occasioning a short delay in starting while the No. 2 fuel oil was heated to get it moving.

The operation with gas fuel during the summer to divert gas to Line No. 1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Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	14" to 18" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5 5/16" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser

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from Line No. 2 (which operates at a discharge pressure of 700 lb) for the benefit of the experimental storage project, and the operation during the fall and winter to improve flow and pressure conditions for delivery of line pack and serve hourly and daily peak loads, are also shown in *Table 1.*

Table 2 gives a "Station Department Summary of Average Operating Conditions, Bonne Terre Station for Year 1951."

In general, the only operating difficulty of any consequence was a shutdown from June 26 to July 10 required to tighten the rotor blading in the slots of the solid type rotor then in use. It was decided that a disc type rotor should be installed as soon as the design and testing by Westinghouse were completed. The summer operation proved that added turbine lube oil cooling would be required. Additional insulation was provided on the Ingersoll-Rand compressor to eliminate icing trouble with the seal oil return pressure reduction valve. No discontinuity of service was occasioned by the cooling or icing problems.

Field compressor station

Experiences in 1952 are tabulated in "Operation of Bonne Terre Station During 1952 With Gas Fuel," *Table 3.* Installation of a field compressor station in the experimental storage field to test deeper formations eliminated the requirement that the turbine station be operated during the summer. It was still required in the fall and winter.

On Jan. 27 a new fuel manifold and dual fuel (oil or gas) nozzles were installed in the combustors. Change in fuel while operating from gas to oil and the return to gas was successful.

On Feb. 22 blade failure occurred and the rotor and stator blading was destroyed. This rotor had been in service for 3228 hours. For the first time in Westinghouse history, we are told, a reblading job on this type of unit was done in the field. One month later, by March 23, repairs were completed. The repaired rotor was used until Nov. 14 and 15 when a shutdown was made to install the new disc type rotor which had been received from the factory. By the end of 1952 the new rotor had been in service 1071 hours. It is still in service.

On the basis of operations to date, these conclusions represent the considered opinions of Mississippi engineers.

ENGINEERS' CONCLUSIONS

1. The 1850-hp internal combustion gas turbine coupled to a centrifugal compressor is a practical unit for compression of gas on pipelines. It is capable of sustained operation and has developed 2000 bhp under test loading. Certain features of the gas turbine unit make it attractive for the solution of specific problems encountered in gas transmission. A station using turbines has a low installation cost per horsepower, requires little space per unit (minimizing the expense of buildings), and requires very little concrete in foundations. No station auxiliaries need be provided except an office, sanitary and drinking water, a minimum of electric power, fuel oil storage facilities if required, and a small storeroom for extra stores and supplies.

2. Regular station personnel is capable of learning quickly to operate and maintain a turbine compressor unit. Our experience indicates that if only a few changes were made in auxiliary equipment the station could be operated with only one person per tour. The turbine is well suited to application of automatic protective and operating devices which may make future designs of such a unit able to function unattended.

3. No instability or flutter in gas compressor operation was found from 110 MMcf/day rate of flow to 233 MMcf/day (corrected to 8750 rpm and 400 psia discharge pressure). The compressor design point was 190 MMcf/day under these conditions. Stable flow rates from 77 to 191 MMcf/day (actual measured—uncorrected for speed or discharge pressure) were handled by the compressor at pressure ratios from 1.225 at 179 MMcf/day (corrected) and 8750 rpm to 1.164 at 216 MMcf/day (corrected) and 8750 rpm. At low speed and high load the compressor developed a pressure ratio as low as 1.139 and at high speed and low load a ratio as high as 1.241. Suction pressures from 228 to 347 psia, which were established during the operating test, made only a slight change in the ratio of pressures developed for an equal flow rate. The unit was very flexible for handling changing loads at low ratios of pressures.

4. The direct connection between the turbine and compressor did not permit independent variation of the compressor speed to use the full horsepower output of the turbine at capacities less than the design flow rates. The data show that the unit operated a considerable portion of the time at less than the 1850 rated hp even though it is capable of producing 2000 hp when proper loading conditions occur in the course of pipeline operation. Another result of this direct connection, and the resulting operation at lower than optimum design rating, is a lower than design thermal efficiency. At these lower flow rates usually experienced in regular operation the thermal efficiency of the turbine varied between 13.5 and 15.5%. At a 2000-hp loading the thermal efficiency of the turbine was 16.5%. It is concluded that separation of the turbine into a turbine to power the air compressor on one shaft with the axial flow air compressor, and a turbine on the other shaft with the gas compressor would permit operation at higher thermal efficiencies and greater range of gas compressor loadings than the simple cycle single shaft unit.

5. Utilization of the exhaust heat of 750° F to preheat the combustion air at 60 psig by heat exchange should improve the thermal efficiency of a simple cycle unit as used in the test. A regenerator was not used in this series of tests because it was not deemed economical for this size unit.

6. The turbine, being a converted railway unit, was equipped with too many devices, controls and supervisory meters, for a unit used for strictly pipeline service.

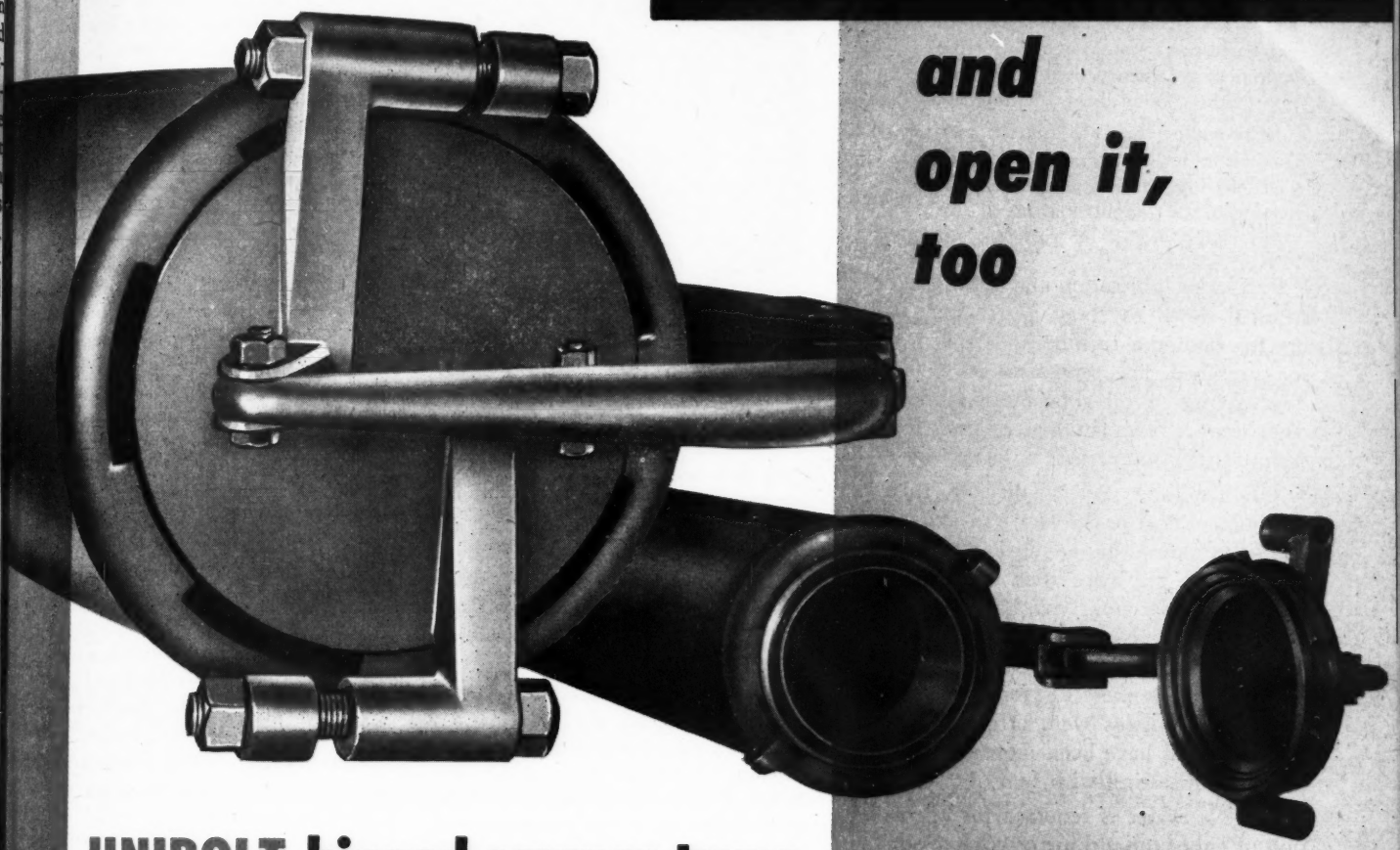
7. Electrical starting facilities should be replaced by some type of gas-operated equipment to make the turbine dependent only on the pipeline gas for starting.

8. The tests have indicated that this converted locomotive turbine could be improved in stationary service by the following changes, many of which have been incorporated in later Westinghouse designs:

a. Placing the turbine end bearing outside the hot gas exhaust stack to reduce heat transfer to the bearing and lubricating oil.

b. Designing supports for the turbine so that combustor heat will not cause distor-

the best way to Shut Your Trap and open it, too



UNIBOLT hinged scraper traps with self-sealing gasket

The self-sealing gasket is shown in cross-section at left. Note the lipped design of the gasket which makes it self-sealing under line pressure.

Just release two bolts and the Unibolt Hinged Scraper Trap swings open like a door. Close it and tighten two bolts. That's how simple and easy it is to operate. There's nothing to drop, no threads to leak, gall, or freeze, no multi-bolt flanges. The Unibolt design places a large area of metal in shear, consequently it is stronger and safer — no danger of failure under line surges or vibration.

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tion and affect the alignment of the turbine.

c. Continuing research to further the design of the rotor.

d. Placing the outlet stack for spent gases far enough from the air intake to prevent dirt and products of combustion vapors from entering the intake air stream to the air compressor.

e. Designing the turbine so that during operation it will furnish its own auxiliary power to prevent shutdowns from power failure. A small gas engine generator or purchased power would be required for operation of emergency lighting and operation of the cooling down rotating motor.

f. Providing combination oil and gas combustors for operation in peak hour and peak day line packing service on the market end of the transmission line to save gas when vitally needed for customer service.

9. Use of lubrication and seal oil has steadied down to about 1 gal. per 24 hrs for both the turbine and compressor combined. This represents a tremendous saving in oil consumption when compared to conventional engine and reciprocating compressor units.

10. The unit used about 238 gals. per hour of fuel or 28 Mcf per hour of 1045 Btu natural gas at full horsepower output. The turbine thus uses about 16,000 Btu per hour per brake horsepower. The type oil that was used was many times more expensive than gas for fuel. Use of Bunker "C," for which the turbine combustors were originally designed, would have been more economical than operating with fuel oil.

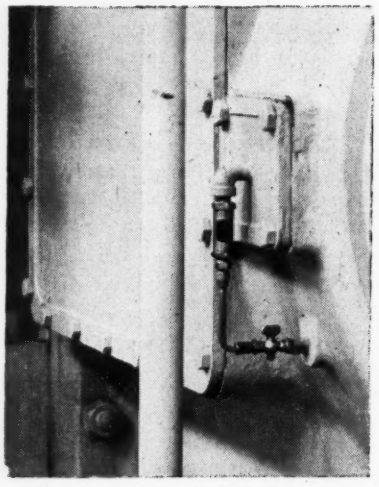
11. No water is required for operation of either the turbine or compressor, which makes the unit very adaptable for intermittent service in cold climates, or for use in locations where water supply is extremely limited.

12. The relatively low ratio of pressures developed by the gas compressor makes it imperative to good overall station efficiency to design the main gas piping for very low pressure drop.

13. For field determination of the horsepower developed, the flow rate through the gas compressor is required. At Bonne Terre the station is close to Meramec measuring station, and the pressure drop occasioned by metering at the compressor station is avoided.

14. Improvement in thermal efficiency by the utilization of higher temperatures on future, more advanced blading material combined with the addition of heat recovery equipment should make this type of unit more desirable to the gas transmission industry.

Visual compressor gas leak detector developed by Topock station manager



A close-up picture of one of the Cooper-Bessemer compressors at Pacific Gas and Electric Co.'s Topock station with a newly developed gas leak detector installed on the cylinder chamber. Operators can readily determine the extent of gas leakage around the connecting rod packing by inspecting oil in the sight glass.

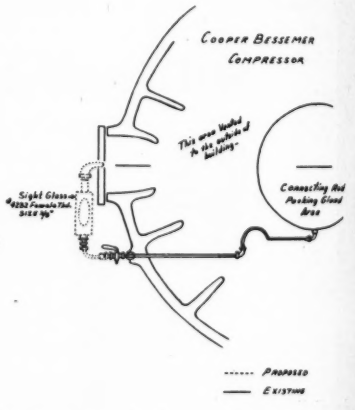
W. V. ADLER, plant foreman at Pacific Gas and Electric Co.'s Topock (Calif.) compressor station, has developed a unique device which will permit continual visual inspection of the condition of the piston connecting rod packing on his Cooper-Bessemer GMW engines.

Basically, the device consists of a sight glass in the vent line which leads to the atmosphere from the connecting rod gland area. Any blow-by of gas or liquid may be observed visually and effectiveness of the packing known at all times. Originally installed on six GMWs at Topock, the sight glasses have proven so effective that they are to be installed on two additional engines at Topock and 10 GMWs at the Hinkley compressor station.

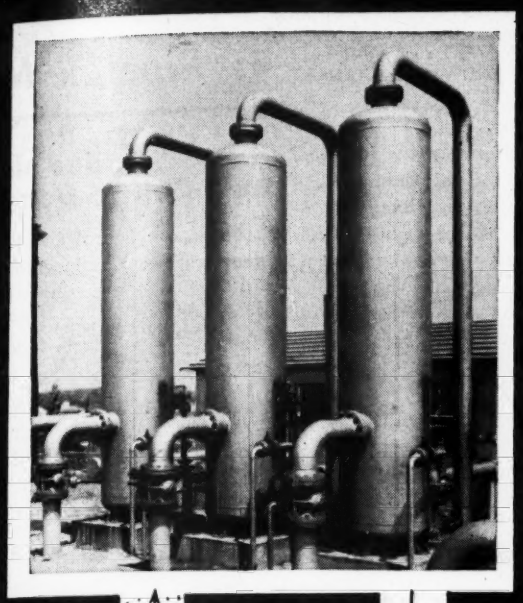
Present design of the packing gland area requires that inspection plates be removed to determine the condition of the connecting rod packing. The only other procedure is to await packing failure as indicated by the presence of gas or liquid in the inspection chamber or vent line from the packing area. If the inspection chamber is vented to the atmosphere, as is usually the case, there is the obvious difficulty in observing gas blow-by. On the other hand, if the inspection plates are permanently removed from the compressor there is the danger of excessive gas in the compressor building when a packing failure occurs.

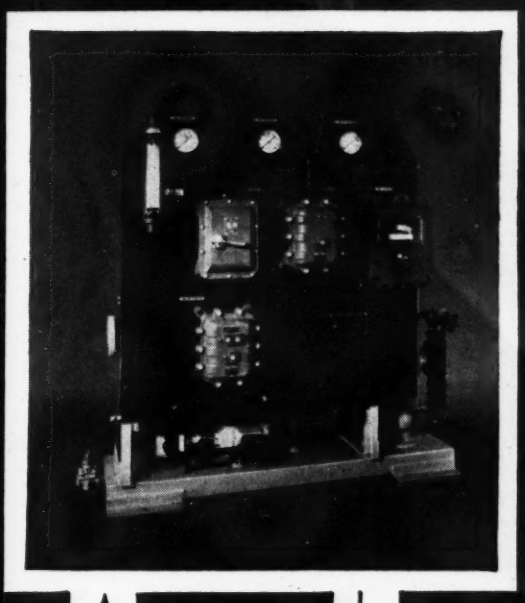
Mr. Adler's sight glass is connected between the packing area vent and a hole in the plate on the inspection area. When the packing is effective, seal oil is vented from around the connecting rod through the vent and can be seen in the sight glass. However, with packing failure, escaping gas will blow the oil out of the vent line and the sight glass. Since the escaping gas is returned to the inspection chamber, which is vented to the atmosphere, there is no danger from excessive gas in the compressor building. A quick check of the sight glass by an operator to determine whether or not the oil has been blown out indicates gas blow-by and effectiveness of the packing. A weakening of the packing is indicated by a bubbling or disturbance in the sight glass.

Materials for the device include a sight glass and the necessary tubing, and connectors for connecting the glass between the vent and the inspection plate. Installation involves drilling a hole in the inspection plate and assembling the unit in place on the compressor.



A drawing of the newly developed gas leak detector which shows the manner in which it is installed on a Cooper-Bessemer compressor. The sight glass is connected between an existing vent from the connecting rod packing gland area and a hole in the inspection plate.





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GAS EQUIPMENT DEPARTMENT
Pittsburgh 22
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Pipeline People

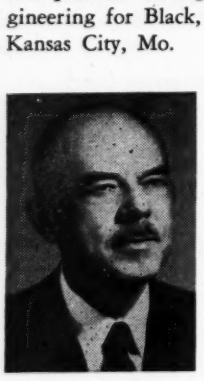
JOHN ALCORN has been promoted to assistant to the president of Cooper-Bessemer Corp.'s foreign sales office in New York City.

A. R. Blotter **J. S. McElwain**
New York State Natural

Promotion of four men in key management positions was recently announced by New York State Natural Gas Corp., Pittsburgh. JOHN S. MCELWAIN was appointed personnel director in addition to his duties as sales manager; ARTHUR R. BLOTTER was elected assistant treasurer; WILLIAM S. BEATTY was made head of the general accounting department; and JAMES G. BERGMAN JR. was named head of the general financial department.

DONALD A. ROBERTSON, assistant secretary and assistant comptroller of Panhandle Eastern Pipe Line Co., has been elected president of the Kansas City Control of the Controllers Institute of America. New president of the Cincinnati control is WILLIAM H. ZIMMER, vice president and treasurer of Cincinnati Gas & Electric Co.

Formerly general manager of engineering, CHESTER A. SIVER has been elected vice president and general manager of engineering for Black, Sivalls & Bryson Inc., Kansas City, Mo.



O. S. Hagerman **C. A. Siver**
Columbia B.S.&B.

After 16 years as an officer of Columbia Gas System companies, OLIVER S. HAGERMAN retired last month as chairman of the boards of United Fuel Gas Co. and six other Charleston group firms. He will remain as a member of the boards for the companies, which include Amere Gas Utilities Co., Atlantic Seaboard Corp., Big Marsh Oil Co., Central Kentucky Natural Gas Co., Virginia Gas Distribution Corp. and Virginia Gas Transmission Corp.

After 40 years of service with the Pittsburgh Group companies of the Columbia Gas System, FRANK WILE, superintendent of production and transmission division two, has retired. Former assistant division superintendent THOMAS E. RIDGE JR. succeeds him. Appointment of WALTER A. PERRIN as superintendent of leases also has been announced.

GADDIS N. YOUNG, formerly chief clerk of the compressor station department for Southern Natural Gas Co., Birmingham, has been named division superintendent of compressor stations east. Q. D. COCKRELL, former superintendent of the east division, now heads the new central division. KENDALL H. ADKINS succeeds Mr. Young as chief clerk.

R. J. Spears **R. R. McCartney**
Clark Bros.

Clark Bros. Co., Olean, N. Y. has named ROBERT R. MCCARTNEY eastern division manager and director of export operations. Succeeding him as New York district manager is ROBERT J. SPEARS, formerly a sales engineer for the district. The company has also opened a new office in Philadelphia naming RALPH C. MCDONALD to head it. He was also a sales engineer out of the New York office.

EVERETT B. ROUDEBUSH has joined Northern Natural Gas Production Co., Omaha, as manager of land and leasing. The past 15 of his 17 years in the petroleum industry have been spent with Gulf Oil Co.

Moving into new offices in the Alcoa building this month, FRANK A. BOYD assumes duties as petroleum engineer in charge of Texas Eastern Transmission Corp.'s Pittsburgh office. He was previously a consulting geologist and engineer.

New vice president of the geological, exploration and land departments of Republic Natural Gas Co., Dallas, is W. BAXTER BOYD.

PAUL KLUTHE recently assumed duties with the mid-continent district sales offices of Kaiser Steel Corp. He made the move to offices in Tulsa from the company's central district sales staff in Oakland.

Pipeline News

New 30-in. line planned from Gulf to Detroit

American Natural Gas Co., New Yor
plans to file application with FPC, probabl
this month, for certificate to construct
1000-mile, 30-in. pipeline from the Gu
Coast to Detroit. Cost of the line, includi
extension of distribution facilities in t
service territories, is estimated at $200 mi
lion. An application was before the Secu
ities and Exchange Commission last mon
for permission to form a new subsidia
American Louisiana Pipe Line Co., to bui
and operate the line.

The huge line would serve Michigan a
Wisconsin markets principally through tr
American Natural subsidiaries, Michig
Consolidated Gas Co. and Milwaukee G
Light Co. It would make available lar
reserves of gas from the Louisiana Gu
Coast, obtained through purchase agr emen
with Stanolind Oil & Gas Co. and Superi
Oil Co. Initial capacity will be from 2
to 300 MMcf daily; this may be expand
to 550 MMcf.

Chairman of the company, William (
Woolfolk, said financing will be handle
step by step as funds are needed and in suc
manner as not to cause dilution per shar
earning power. "We are convinced that th
gas reserves are needed," he said, "that th
new pipeline will add to the strength of th
system and that the additional available ga
will readily find a market."

The recent acquisition of additional sto
age fields in Michigan, which more tha
double the company's potential storage to
total of 110 billion cu ft, makes possible a
operation similar to that of another Ame
ican Natural subsidiary, the successful Mic
igan-Wisconsin Pipe Line Co. system.

FPC approves New Englan split market agreement

FPC has approved the agreement (s
August *GAS*, p. 48) between the Algo
quin Gas Transmission Co. and Northea
ern Gas Transmission Co. to split the Ne
England market, thus ending a four-ye
battle between the rival groups.

Under the settlement, Algonquin wi
serve markets in New Jersey, Rhode Islan
and parts of Connecticut and Massachusett
while Northeastern will serve customers i
Maine, New Hampshire, and parts of Co
necticut and Massachusetts. Algonquin
wholesale supplier and part owner is Tex
Eastern Transmission Corp., while North
eastern's parent is Tennessee Gas Transmi
sion Co., which sought to serve the entir
area and contested the award of an FPC ce
tificate to Algonquin to serve the southe
portion of the region.

There still is a chance of a court appe
which could block the full extension of ser
ice in the area next winter. Some rumo

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We can supply you with Claymont Welded Steel Pipe to handle any gas transmission job large or small . . . in lengths of 40 feet and in overall diameters from 22 inches through 36 inches. Special lengths and diameters can be provided if required. For complete information, write or call Claymont Steel Products Department, Wickwire Spencer Steel Division, Claymont, Delaware, or our nearest sales office.

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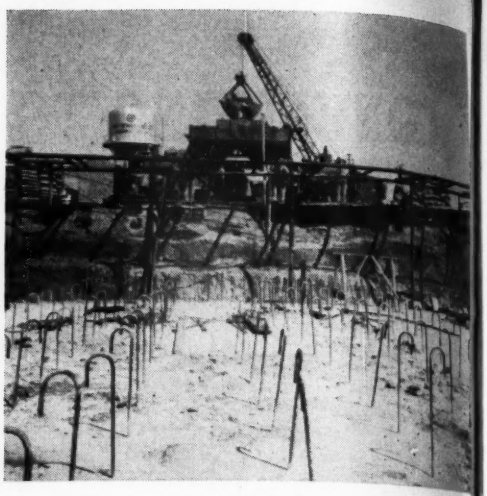


Two vital installations, boosting the capacity of Cities Service Gas Co.'s 26-in. line from Ulysses, Kan., to Kansas City, Mo., are nearing completion. At Hesston, six GMV 10 compressor engines like the one shown at left are being installed in a new station, which will be completed Oct. 1. At the Greensbur station, three engines are being added to a bank of four, wit completion scheduled for Oct. 15. Photo shows preparation for laying foundations.

have it that the order may be appealed to the federal courts unless Northeastern and Tennessee Gas are granted an FPC permit to export natural gas to Canada as compensation for loss of the New England territory. The FPC's opinion set this angle aside for a separate ruling. The commission, while going along with the agreement generally, specifically refused to be bound by any agreement or compromise drawn up between the contesting parties for the sake of a settlement.

FPC accepts settlements for three rate increases

In rate proceedings the past month the FPC approved proposed settlements on three increases. In all cases the amounts settled upon were lower than originally requested. Applications for increases for two other companies were suspended.

Settlements approved included a $13.7 million increase for Tennessee Gas Transmission Co., Houston, instead of the $16.9 million originally proposed (see *GAS*, August, page 104). The FPC order requires the company to refund the difference between the two rates, which had been collected under bond since Feb. 15.

Also accepted was the settlement for an increase of $8.5 million for Texas Gas Transmission Corp., Owensboro, Ky. instead of its proposed $8.75 million. The increase became effective Sept. 1 and refunds will be made for the difference in the amounts collected between Jan. 8 and Sept. 1. The increase is $2 million less than the annual cost of service figure the company had presented.

United Gas Pipe Co., Shreveport, filed a new rate schedule amounting to a reduction of $113,000 annually for its customer Willmut Gas & Oil Co. in compliance with a June 1 order of the commission. The tariff was accepted, but the commission suspended a subsequent application for increase in accordance with the company's proposed increase now under suspension, which would cancel the Willmut rates.

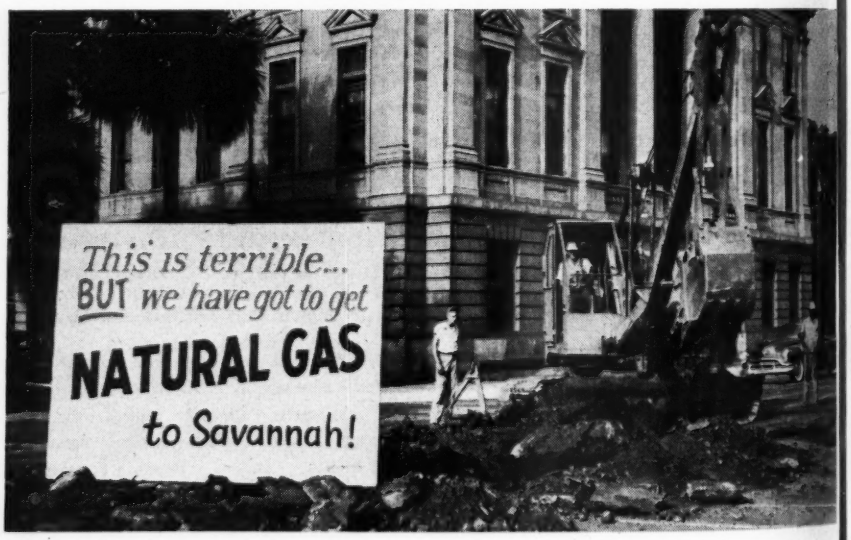
Proposed increases suspended were $5,857,600 for Texas Illinois Natural Gas Pipeline Co., about 15% annually, and $13,485,500 for Northern Gas Co., about 19.5% annually.

Two New York firms granted FPC okay for expansion

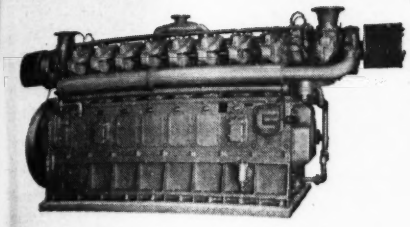
The FPC has issued certificates authorizing facilities proposed in three applications by New York State Natural Gas Co., New York City, and New York State Electric & Gas Corp., Ithaca. Construction of a metering station and interconnection with facilities of the other company was authorized for New York State Natural. Cost of th facilities is estimated at $35,920. It will se up to 500 MMcf annually, and 4 MMcf dail maximum, to New York State Electric.

Authorization for 49 miles of 10- and 8 in. pipeline was granted New York Stat Electric, to connect existing manufacture gas systems in Norwich and Oneonta with New York State Natural's facilities. These cities will then be converted to natural gas, in addition to the communities in Madison, Chenango, and Otsego counties along the route of the line.

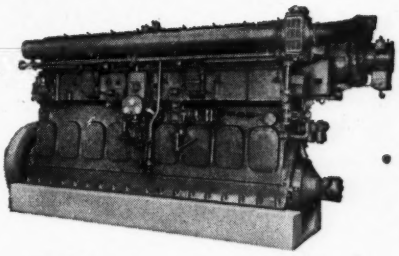
The second certificate issued this company grants final authorization for 9.5 miles of line between Auburn and Seneca Falls, and addition of 2200 hp at a compressor station in the Auburn area. Temporary authorization for these facilities was granted last September. Total cost of the two projects i estimated at $2,650,000.



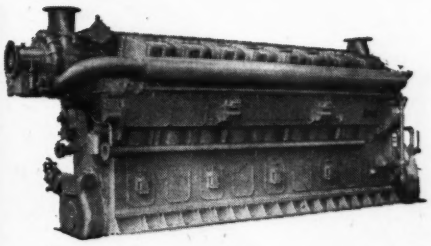
This frank message from the president of South Atlantic Gas Co. is helping the company to hold public good will during the troublesome business of laying the natura gas pipeline down one of Savannah, Ga.'s main streets. Hansell Hillyer, president o South Atlantic Gas, received so many friendly calls as a result of the sign that it has become a fixture on conversion work.



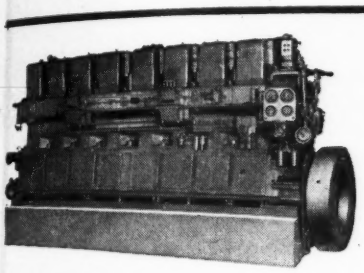
TYPE FVA.....8, 12 or 16 cyl.
Diesel — Atmospheric ..... 430 to 1150 hp.
Diesel — Supercharged .....1110 to 2230 hp.



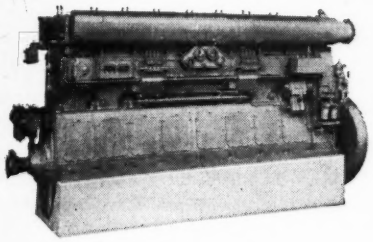
TYPE LS.....6, 7 or 8 cyl.
Atmospheric and Supercharged
Gas .....720 to 2500 hp.
Diesel .....825 to 2500 hp.
Gas-Diesel .....825 to 2500 hp.



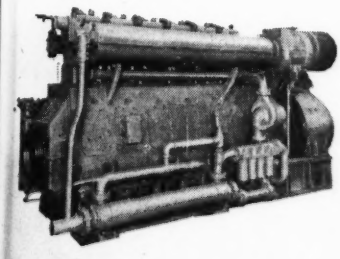
TYPE LSV .....12 or 16 cyl.
Atmospheric and Supercharged
Gas .....1440 to 5000 hp.
Diesel .....1650 to 5000 hp.
Gas-Diesel .....1650 to 5000 hp.



TYPE JS .....5, 6, 7 or 8 cyl.
Atmospheric and Supercharged
Gas .....375 to 1815 hp.
Diesel .....430 to 1815 hp.
Gas-Diesel .....430 to 1815 hp.



TYPE GS .....5, 6 or 8 cyl.
Atmospheric and Supercharged
Gas .....320 to 1460 hp.
Diesel .....300 to 1460 hp.
Gas-Diesel .....300 to 1460 hp.



TYPE FW .....6 cyl.
Diesel — Atmospheric .....245 to 500 hp.
Diesel — Supercharged .....350 to 835 hp.

it pays to meet power and compressor needs "right on the nose" . . with COOPER-BESSEMERS

• Think a moment about the importance of meeting engine or compressor needs with machines that are exactly *right* for the job. With Cooper-Bessemers you have this assurance, as evidenced by the broad range of units shown here — all standard, proved Cooper-Bessemers, engineered to give *maximum* return in any kind of service you can name, from 300 to 5,000 bhp. Note, too, the flexibility offered by each basic engine type — in number of cylinders, aspiration, horsepower range and fueling.

As important as these things are in meeting your requirements without needless waste *or* shortcomings, Cooper-Bessemers have long been known for additional plus values . . . sturdiness, long life, low maintenance and unmatched efficiencies for lower over-all cost every time! There are new bulletins, yours for the asking, to give you the latest information on Cooper-Bessemer engines or compressors just right for your needs.

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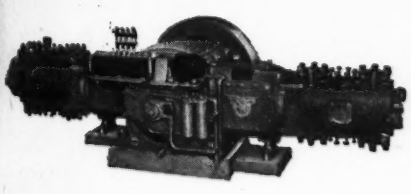
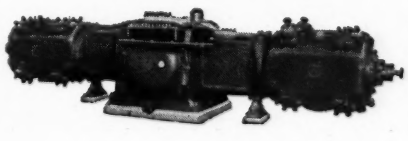
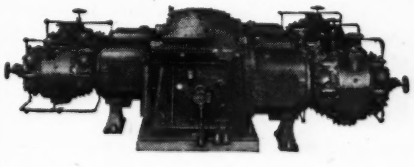


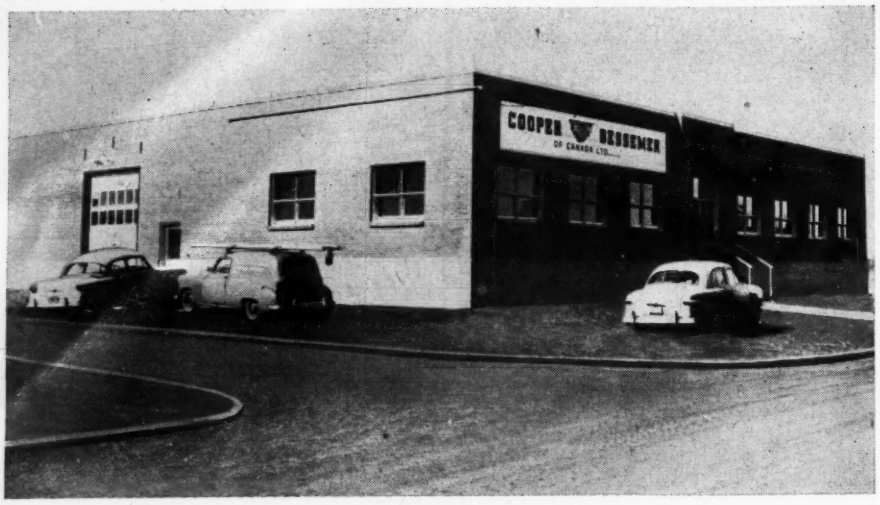
TYPE EM
To 350 hp.
9" stroke
Speed to 514 RPM



TYPE FM
To 1500 hp.
10½" stroke
Speed to 514 RPM



TYPE JM
500 to 3000 hp.
14" stroke
Speed to 327 RPM



Cooper-Bessemer of Canada Ltd. recently opened its newest branch office and parts warehouse in Edmonton, Canada, to provide prompt factory service on parts for the company's diesel, gas-diesel, and gas engines, as well as for its gas engine-driven compressors. Edward D. Van Fossen (left), formerly of Cooper-Bessemer's Seattle office, is in charge of the new sales office and parts warehouse. Al Rothenbuhler and William Munro head the factory-trained service staff in Edmonton.

Arguments become hotter in dispute over Northwest gas

The dogfight over whose gas will be burned in the ranges of the Pacific Northwest—and the related fight over export of Alberta's gas to eastern Canada—continued to rage through August's heat, with a final settlement remaining a remote possibility.

While far from inclusive, bulletins on the fight's progress were issuing practically daily. Highlights of late July and August:

July 22—FPC hearings reopened, with markets the first order of business.

July 24—In Calgary, Ford, Bacon & Davis engineers said that Trans-Canada Pipe Lines could sell Alberta gas for 55 cents in Ontario and Quebec. The $252 million (immediate cost) line would serve more than 200 communities with 4.5 million combined populations.

July 26—The president of the Washington Assn. of Realtors announced he favored Canadian gas. "It will be better for us to send our money to Canada than to send it to New Mexico where it will enrich more Texans, who don't buy much from Washington."

July 28—W. F. Devin, counsel for Pacific Northwest, said Mr. Balch was ignoring "discrimination against important parts of our state by the Canadian applicants."

July 29—Atty. J. W. Greenough of Spokane, attorney for Trans-Northwest Gas Co., which would relay Canadian gas to distributors, told FPC deliveries would be made to "all communities within economic reach in the intermountain area."

July 29—In Montreal, the Ontario government presented a brief to the Alberta Gas Conservation Board at a special hearing, urging construction of the all-Canadian line without delay, on the basis of market needs.

July 30—Westcoast Transmission Co. told FPC it expects to sell 7 billion ft in its first year to British Columbia markets. Prince George, Kamloops, Quesnel, Williams Lake, and Merritt would be served by the new Inland Gas Co. Ltd.

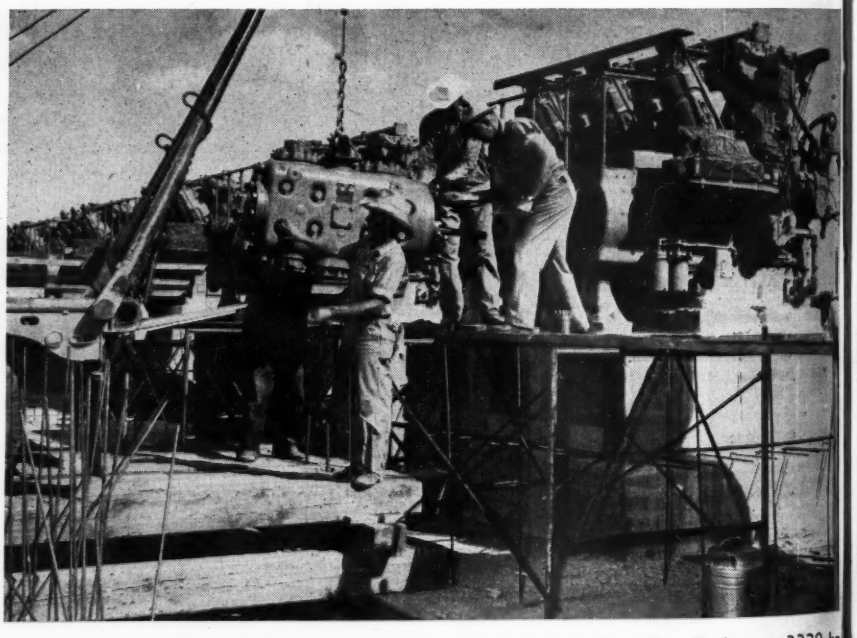
July 31—In adjourning the Calgary hearings to Aug. 24, I. N. McKinnon, chairman of the Alberta Gas Conservation Board, hinted there was plenty of gas for export. He urged distributors, particularly those in eastern Canada, to indicate their needs and make price offers.

Aug. 5—Spokane Gas & Fuel Co.'s president, Frank A. Woodwirth, told FPC he was opposed to paying an estimated 8 cents more than coastal cities for Canadian gas. He said he hoped gas would wipe out the fuel price disparity now existing. He said he would not sign a contract with Trans-Northwest without making a new survey to determine how much gas could be sold at the higher rate.

Aug. 6—At the governors' conference in Seattle, Dan Thornton* of Colorado, Paul Patterson of Oregon, and Bracken Lee of Utah lined up for U. S. gas. Washington's Langlie and Idaho's Jordan were neutral. New Mexico's Mechem wasn't sure there was enough gas in San Juan to permit further export.

Aug. 11—Pacific Northwest announced that testimony had disclosed Westcoast planned to deliver an added 7 billion cu ft per year on the Canadian side of the border—to Victoria and other Vancouver island communities—a fact "not included in exhibits already filed" by the company. Pacific said General Sales Manager H. N. Walters testified his company would "rely on provision of the Canadian law which makes the service to the Canadian customers a precedent to the export of gas" to obtain gas that might be needed "above present estimates." Pacific also announced it has reserves of 3.6 trillion cu ft, and that it would serve an area of 3 million population against 2 million for Westcoast. Pacific said Phillips Petroleum had dropped its field price from 7 cents to 6 to offset rising construction costs.

*Said Thornton, whose state bitterly opposed export two or three years ago, "Colorado is confused and amazed at the thought of not being able to find a market for its gas in the Pacific Northwest."



Workmen swing compressors into place on engines at Lone Star Gas Co.'s new 3320-hp Jacksboro compressor station in Jack county, Texas, as station nears completion.

Johns-Manville announces a new lightweight, reinforced asbestos pipe line felt . . .

New Transhield Asbestos Pipe Line Felt

. . . designed for low cost tear-free application

Transhield is a lightweight felt, reinforced with continuous glass yarns, parallel spaced on ¼″ centers to give tear-free application strength. Made of coal-tar saturated asbestos, Johns-Manville Transhield Asbestos Felt acts as a continuous barrier to shield pipe line enamels from earth loads and soil stresses.

As an outer sheath to retard cold flow, Transhield takes advantage of the full thickness of the enamel coating—working effectively toward preserving a continuous film of enamel on the pipe line.

Long-Length Rolls—Available in 800-ft. rolls (14″ O.D., 2″ I.D.) for traveling power-driven coating and wrapping machines. Other lengths can be furnished to suit your method of application. Widths are from 2″ to 36″.

• • •

Johns-Manville has developed three wrapping materials for pipe line protection:

J-M 15-lb. Asbestos Pipe Line Felt (perforated or unperforated)—for severe soil conditions.

J-M Transhield Asbestos Pipe Line Felt—for average soil conditions.

J-M Trantex polyvinyl pressure sensitive tape—for pipe line corrosion protection where ease of application is important such as for emergency repairs and for coating field joints of mill-wrapped pipe.

For further information write Oil Industry Department
Johns-Manville, Box 60, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville ASBESTOS PIPE LINE FELT

Lone Star completes plans for new 36-mile line

Lone Star Gas Co., Dallas, has completed plans for construction of a 36-mile 12-in. pipeline from its compressor station near Abilene to a connection with company facilities near Stamford. The new line will strengthen the supply for towns in eight west Texas counties. Cost of the line, which will have a maximum capacity of 30 MMcf daily, will be more than $838,000. Gas will come through present delivery facilities from supplies in Scurry county, the Runnels county area, Lone Star's underground storage at View near Abilene, and the Abilene-Sweetwater producing area.

Notes

FPC has appointed William J. Grove, Camp Hill, Pa., as assistant general counsel in charge of natural gas matters. He succeeds Bernard A. Foster Jr., who resigned May 30.

The Independent Natural Gas Assn. of America will have Jerome K. Kuykendall, chairman of the Federal Power Commission, as its banquet speaker during its annual meeting Sept. 28-29 at the Shamrock hotel in Houston. Other speakers will include L. F. McCollum, Continental Oil Co.; Ernest O. Thompson, Texas Railroad Commission; James F. Oates Jr., Peoples Gas, Light & Coke Co.; and Edward P. McCormick, American Stock Exchange.

Texas Eastern Transmission Corp., Shreveport, has filed an application with FPC for construction of a total of 17 miles of 6- and 8-in. lateral lines and a new 4400-hp compressor station in Shelby county, Texas, on its new Provident City-Castor line. The new facilities will allow it to transport additional quantities of gas from the Englehart field and Big Hill field in Texas. The company has contracted for more than 21 MMcf of gas daily from Wilcox Trend Gathering System Inc. and these fields.

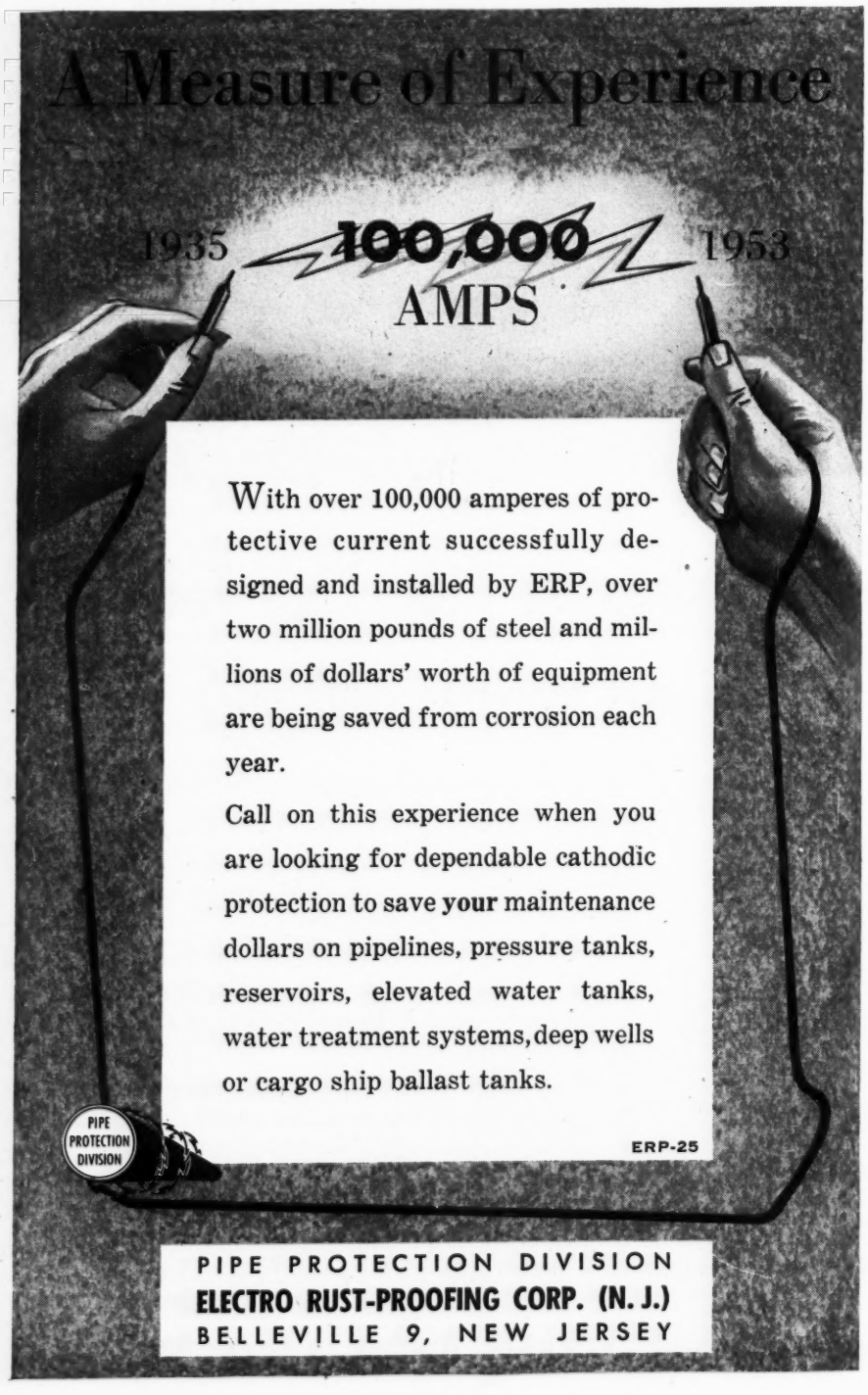
FPC has postponed oral argument on its proposed amendment to the uniform system of accounts regulation. The amendment would provide a new account for future income taxes resulting from accelerated amortization. Time for submission of data, views and comments has been extended to Oct. 1.

Hope Natural Gas Co., Clarksburg, W. Va., has been authorized to develop an underground natural gas storage pool in Lewis and Harrison counties, W. Va. at an estimated cost of $1,236,000. It will construct about 19 miles of line to change the Kennedy gas field from a producing area to storage, recondition 46 wells and redrill 15. Capacity of the pool will be about 20 billion cu ft, of which 10 billion will be active. Estimated withdrawal rates will be about 100 MMcf with a maximum of 125 MMcf.

Mississippi River Fuel Corp., St. Louis, has been granted a rehearing, scheduled for Sept. 28, on its proposal to supply natural gas on an interruptible basis to Union Electric Co. of Missouri. FPC had denied Mississippi's application in an order issued May 11. All exhibits and prepared testimony are to be submitted by Sept. 21.

Ohio Fuel Gas Co., Columbus, recently completed conversion of its Mt. Sterling compressor station at a cost of $43,790. The station, previously used as a booster station, has been changed to two-way operation so flow can be reversed to deliver gas to underground storage areas during summer months. It will still function as a booster station to send gas to consumers in western Ohio. Scrubbers with twice the capacity as the old ones have been installed.

Final affirmation has been made by FPC granting El Paso (Texas) Natural Gas Co. the right to acquire pipeline facilities from West Texas Gas Co. and to serve Southern Union Gas Co. through those facilities. This eliminates West Texas as the middle-man in the operation. El Paso will also construct a new metering station at the point of delivery to Southern Union. (See August *GAS*, p. 104.)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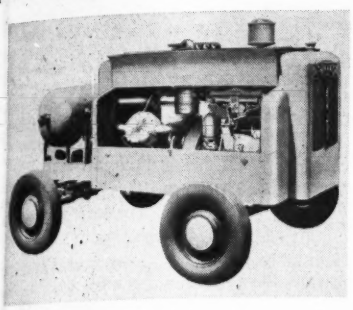
New Products

For additional information on these products use coupon on p. 64.



17 Portable Compressor

A new 160-cfm portable compressor, the Super Chief 160, is now available in 2-wheel and 4-wheel trailer and skid mountings from Davey Compressor Co. From 200 to 1000 lbs lighter than other compressors of the same capacity, it has two low pressure cylinders with 6-in. bore and 3¾-in. stroke, and one high pressure cylinder with 5¼-in. bore and 3¾-in. stroke. It is available for use with gasoline or diesel fuel. Net weight is 4300 lbs.

Davey Compressor Co.

18 Pipe Clamp

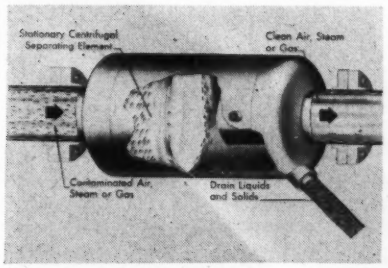
A new Tipton clamp with No-Tack crossbars eliminates tacking and allows stringer bead to be completed before lineup clamp is removed. Both standard and hydraulic clamps are available with No-Tack crossbars. The jack on the all-position hydraulic clamp has a travel of 2¾ in. for quick and easy clamping around the pipe. A lever releases the self-retracting jack.

General Manufacturing Co.

■

19 Gas Purifier

A new Hi-eF purifier has been designed for use on natural gas lines by V. D. Anderson Co. It provides an economical means


Stationary Centrifugal Separating Element
Clean Air, Steam or Gas
Contaminated Air, Steam or Gas
Drain Liquids and Solids

of removing wet and dry particles, up to 99%, from gas lines at compressor stations. A stationary centrifugal element sets the vapor into a rapid rotational motion which draws all solids and liquids out to the walls of the purifier where it is collected and ejected through a drain.

V. D. Anderson Co.

■

20 Ditching Machine

The new model truck-mounted Earthripper ditching machine, with digging speeds from 1 to 44 ft per minute, features a jackknife boom that is raised and lowered hydraulically. The new design reduces the head room of the machine, permitting it to travel beneath any obstacle that provides clearance for the truck. The boom also permits extending the bucket line at an angle behind the machine, to start the ditch flush against walls, embankments, etc. The Earth-

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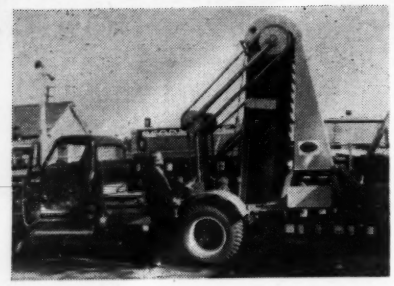


ripper, which derives its power from the truck motor, digs ditches from 8 to 24 in. wide. Special machines for digging 8 ft deep are also produced.

Owen-Pewthers Ditcher Co.

Progress Reports

PLANNED

CAROLINA NATURAL GAS CORP., Charlotte, N. C. Docket G-1956 for 40 miles of line to connect with Transco line near Kings Mountain, N. C., extending to Rock Hill, S. C., with laterals to four South Carolina points.

CENTRAL KENTUCKY NATURAL GAS CO., Charleston. Docket G-2192 for 5 miles of 20-in. lateral extending from connection with Gulf Interstate in Menifee county, Ky. to its own Means, Ky. compressor station.

CENTRAL WEST UTILITY CO., Kansas City. Docket G-1682, four alternate plans to serve Clay county, Mo.

CHATTAHOOCHEE NATURAL GAS CO., Birmingham. Docket G-2066 for 70 miles of line in northwest Georgia, to connect with system of Southern Natural in Floyd county.

CITIES SERVICE GAS CO., Oklahoma City. Docket G-2149 for 69 miles of line—44 miles 20-in.; 25 miles 16-in.—and 1100-hp addition to Edmond compressor in Oklahoma county.

COLORADO INTERSTATE GAS CO., Colorado Springs. Docket G-2121 (1954 program) 365 miles of 22-in. line from Denver to connection with proposed Pacific Northwest Pipeline Corp. line at Green River, Wyo., with 5500-hp compressor station at Green River.

EAST OHIO GAS CO., Cleveland. A 125-mile, 26-in. pipeline to serve Cleveland area from point just south of Toledo.

EQUITABLE GAS CO., Pittsburgh. Docket G-2130 to activate the Logansport storage field in the Big Injun Sand, Marion county, W. Va., install a 1320-hp compressor station in Wetzel county, about 9 miles of 12-in. line from storage pool to compressor station, and various 6-in. and 8-in. well connecting lines.

GLACIER GAS CO., Butte, Mont. Dockets G-1816, G-1817, G-1818 for 285 miles of 20-in. line from northeast of Kalispell, Mont. to Spokane, Wash.; 91 miles of 8⅝-in. from Spokane to Lewiston, Idaho; 120 miles of 16-in. from Spokane to Hanford, Wash.; 130 miles of 12¾-in. from Spokane to south of Trail, B. C.

KANSAS-NEBRASKA NATURAL GAS CO. INC., Phillipsburg, Kan. Docket G-2186 for 41 miles of line in Kansas and Nebraska, and a new compressor station from items salvaged from abandoned station.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh. Docket G-2193 for 72 miles of 20- and 16-inch line, 38.7 miles of storage and well lines, 2 measuring stations and a 1760-hp compressor station at the Victory storage field in Marshall and Wetzel counties, W. Va.

MISSOURI CENTRAL NATURAL GAS CO., Macon, Mo. Docket G-1509 for 25 miles of 6-in. from Moberly to Macon, Mo.

MISSOURI PUBLIC SERVICE CO., Warrensburg. Docket G-2057 for 109.3 miles of 8- and 10-in. mainline and 27.1 miles of lateral lines. System to connect with Panhandle Eastern Pipeline Co. line at Franklin, Mo. and extend northwest.

MORGANFIELD NATURAL GAS CO., Morganfield, Ky. Docket G-1935 for a 31-mile, 4- and 6-in. line lateral to proposed Texas Gas Transmission Corp. line, to serve 6 Kentucky towns.

NEW YORK STATE NATURAL GAS CORP., Pittsburgh. Docket G-1980 (in part) for a 75-mile, 20-in. line from southern end of Driftwood field line to main dual line in Armstrong county, Pa. To be constructed in 1953.

NORTHERN NATURAL GAS CO., Omaha. Docket G-1918 for 400 miles of 24-in. pipe from the United States-Canadian border to a point near Minneapolis and two compressor stations with 5280 hp each.

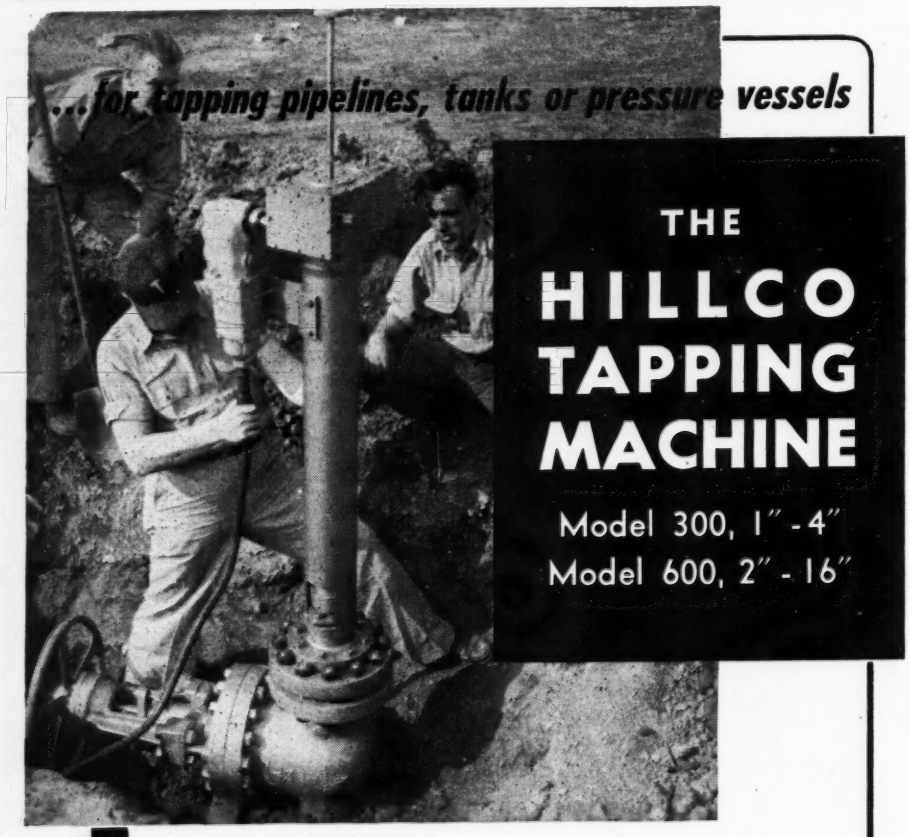
NORTHERN NATURAL GAS CO., Omaha. Docket G-2009 for a 1.4-mile, 8⅝-in. branch line from its Omaha branch line to a proposed regulating station near La Platte in Sarpy county, Neb.

NORTHERN NATURAL GAS CO., Omaha. Docket G-2063 (in part-second year program) for 204 miles of 24-, 26- and 30-in. mainline additions to connect with Permian Basin Pipe Line Co. system, and 22,800 hp in new and existing stations in Texas, Oklahoma, Kansas, Nebraska, Iowa, Minnesota and South Dakota.

NORTHWEST NATURAL GAS CO., New York. Docket G-996 for 992 miles of 18-, 20-, 22-, and 24-in. line in Washington, Idaho, Oregon and British Columbia, together with laterals and four compressor stations aggregating 30,800 hp.

OHIO FUEL GAS CO., Columbus. Docket G-2194 for 69 miles of 20- and 24-in. lines and 3000-hp addition to Crawford compressor station.

PACIFIC NORTHWEST PIPELINE CORP., Hou-



THE HILLCO TAPPING MACHINE

Model 300, 1" - 4"
Model 600, 2" - 16"

The HILLCO Tapping Machine is designed to tap high-pressure or high-temperature pipelines, tanks or pressure vessels (Oil, Natural Gas, Gasoline, or Water). For tapping through gate valves from 1" to 16" (Plug Valves 2" to 4", Special cutters are available for use with other valves having restricted openings). Larger sizes designed to operate with air motor. The HILLCO Tapping Machine is shop tested at 2000 p.s.i. for operation at 1000 p.s.i., and is also equipped with high-temperature packing.

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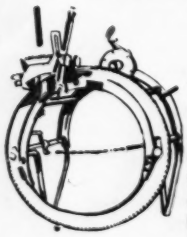

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ton. Docket G-1429 for 1466 miles mainline; 380 miles of spur and lateral lines; and 16 compressor stations totaling 104,420 hp, to extend from Ignacio, Colo., in the San Juan basin, to Bellingham, Wash. (Seattle area).

SHENANDOAH GAS CO., Lynchburg, Va. Docket G-1448 for 39 miles of line from a point near Middletown, Va. to points near Winchester, Va. and Martinsburg, W. Va.

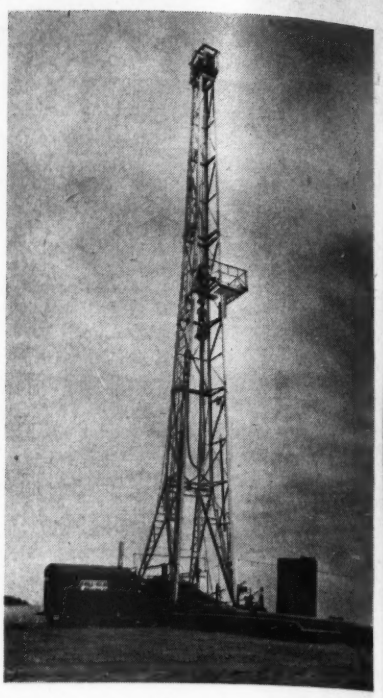
SOUTHERN NATURAL GAS CO., Birmingham. Docket G-2065 for line tap and metering and regulating facilities to supply Chattahoochee Natural Gas Co. Also Docket G-2196 for 9.5 miles of 6⅝-in. lateral to Thomaston, Ga.; and Docket G-2208 for 2 miles of 12¾-in. loop along Macon lateral.

TENNESSEE GAS TRANSMISSION CO., Houston. Docket G-1969 for certificate to perform natural gas transmission service for Niagara Gas Transmission Ltd., Toronto, and Iroquois Gas Corp., Buffalo. To construct 574-mile, 30-in. line from Kinder, La. to join existing system; 130 miles of loop line; a 45-mile spur from near Buffalo to international border; submerged crossing of the Niagara river; 17,520 hp additional at existing compressor stations; 3 new stations; and 158 miles of lateral lines.

TEXAS EASTERN TRANSMISSION CORP., Shreveport. Docket G-2208 for 17 miles of 6 and 8-in. lines to connect with Englehart and Big Hill gas fields; a 4400-hp compressor station in Shelby county, Texas.

TRANS-CANADA PIPE LINES LTD., for 2200-miles 30-in. line from Alberta to Toronto; 24-in. line from Toronto to Montreal with 14-in. line to Ottawa; 747-mile gathering system and 13 compressor stations totaling 94,160 hp.

TRANS-NORTHWEST GAS INC., Spokane. Docket G-2111 for construction of a 521-mile system to serve markets in eastern Washington and northern Idaho, starting at international border near Osoyoos, B. C., south to Hanford, Wash., east to Spokane and Wallace, Idaho, north again from Spokane area to Trail, B. C.



Despite some oil showings, Laclede Gas Co., St. Louis, was continuing drilling operations last month in an effort to develop a suitable gas storage field in an area close to the city.

UNITED FUEL GAS CO., Charleston. Docket G-2192 for 88 miles of 30- and 20-in. line connecting a new 6000-hp compressor station to its own lines in W. Va., and that of Gulf Interstate in Boyd county, Ky.

WESTCOAST TRANSMISSION CO. INC., Wilmington, Del., 396 miles, including 270 miles from Sumas, Wash. to Portland, Ore. with short branches to a number of cities in the two states, and 126 miles of laterals and 26 measuring stations. To connect with 662-mile, 24-in. line to be built by parent company, Westcoast Transmission Co. Ltd., from Peace river area of Alberta and British Columbia. Survey under way.

UNDER WAY

ALGONQUIN GAS TRANSMISSION CO., Boston. Facilities including several laterals remain to be completed. FPC has approved completion. Contractors are Perna Bros., Associated Pipe Line Contractors, Consolidated Gas & Service, and Fulghum Contracting Corp.

CHICAGO DISTRICT PIPELINE CO., Joliet, Ill. Docket G-2090 for 3.4 miles of 36-in., 15.7 miles of 30-in. and a .2-mile river crossing of 24-in. pipe in the Chicago area. Expect completion Dec. 1.

CITIES SERVICE GAS CO., Oklahoma City. Docket G-2038 for installation of 11,400-hp compressor capacity—three 1600-hp units to be added to its Greenburg station, Kiowa county; six 1100-hp units in a new station in Harvey county, Kan. Expected to be complete Oct. 15, 1953.

EL PASO NATURAL GAS CO. Work in progress on plant construction for 153,000 hp in mainline and booster compressor stations.

GULF INTERSTATE GAS CO., Houston. Docket G-2058 to construct 860 miles of 30-in. line from Rayne, La. to Boyd county, Ky., 229 miles lateral lines and five 8000-hp compressor stations in four states. Contracts let to H. C. Price and Houston Contracting Co. Work under-

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COMPANY_____

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way, and expect completion Nov. 1, 1954.

LONE STAR GAS CO., Dallas. A 73-mile gathering and transmission system in Jack and Wise counties with a 3320-hp compressor station—the Jacksboro. Expect completion early fall.

NEW YORK STATE ELECTRIC & GAS CORP., Ithaca. Docket G-1999 for total of 49 miles of pipeline; 25 miles 10-in. from DeRuyther to Norwich, N. Y., 24 miles 8-in. from Norwich to Oneonta, N. Y. Construction begun in July. Completion expected Nov. 15.

NEW YORK STATE NATURAL GAS CORP., Pittsburgh. Williams-Austin Co. has contracted for 10.8 miles of 20-in. line from Craigs Corners to Caledonia, N. Y.

NORTHERN NATURAL GAS CO., Omaha. Docket G-1618 for 213 miles of 26-in. loop lines in Texas, Oklahoma, Iowa, Kansas, Nebraska and Minnesota, and 100,160-hp additional compressor capacity. Expect completion in October.

NORTHERN NATURAL GAS CO., Omaha. Docket G-2063 (in part—first year program) for 259 miles of 24- and 30-in. pipe and 50,400 hp in compressor capacity in new and existing stations in Texas, Oklahoma, Kansas, Nebraska and Iowa. Also 475 miles of branch lines and additions to serve Iowa, Minnesota, Nebraska and South Dakota. G. G. Griffis Inc., R. H. Fulton & Co. and Lone Star Contractors at work on mainline. All jobs under construction. Expect completion December.

PACIFIC GAS & ELECTRIC CO., San Francisco. Docket G-1651 for 86.25 miles, 34-in. loop and 19,540 hp addition on existing Topock-Milpitas line. Engineers Limited Pipeline Co. at work on loop construction. Bechtel Corp. at work at Topock, Hinkley and Kettelman compressors.

PACIFIC GAS & ELECTRIC CO., San Francisco. Docket G-1892 for 15 miles of 20-in. pipe extending from Helm and joining the system's Topodk-Milpitas line in Fresno county; and for 15.5 miles of 12¾-in. in Madera county parallel to the existing Madera-Livingston line. 5 miles of 20-in. scheduled for fall completion; 5 miles of 12-in. completed Sept. 1.

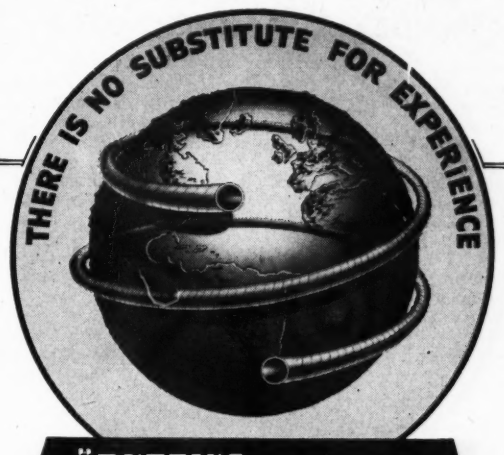
PERMIAN BASIN PIPELINE CO., Omaha. Docket G-1928 for 234 miles of line and 54,880 hp in compressor stations to carry gas from Upton, Midland, and Pecos counties, Texas and Lea county, N. M. to connection with 24-in. El Paso Natural line to Dumas, Texas. R. H. Fulton at work on mainline. Completion in December.

SOUTHERN COUNTIES GAS CO., Los Angeles. Alex Robertson Co. at work on 12-mile, 10-in. line from San Luis Obispo to Arroyo Grande; 2-mile, 10-in. line from San Luis Obispo to connection with Paso Robles line; a 330-hp station at Arroyo Grande. L. E. Webb Construction Corp. to complete 6 miles of 12-in. south of Santa Maria in September.

SOUTHERN NATURAL GAS CO., Birmingham. Docket G-1907. Total project approved including 792 miles of line and 18,500-hp compressor capacity—about 522 miles of looping on existing system with addition of 5400 hp to existing stations, about 270 miles in new lines and 3 new compressor stations. Miscellaneous sized lines for gathering system, 384 miles to be laid south of Gwinville, Miss.; add 5400-hp compressor at Gwinville; new 5400-hp station at Ellerslie, Ga.; 4400-hp station at Macon, Ga; and 3300-hp station at Toca, La. Brown & Root Inc., H. C. Price Co. and Houston Contracting Co. at work with completion expected in 1954.

TEXAS ILLINOIS NATURAL GAS PIPELINE CO., Chicago. Docket G-1914 for six new compressor stations totaling 70,000 hp on its Texas to Illinois transmission line and installation of additional units totaling 10,000 hp at five existing stations. Also for construction of a suspension bridge across the Mississippi river and lateral lines to connect additional gas reserves to system. Contracts have been let for compressor work. Completion date, Dec. 1.

UTAH NATURAL GAS CO., Salt Lake City. To build a 62.8-mile 18-in. pipe from fields in Carbon, Emery and Sanpete counties running northwest to a point near Provo. R. H. Fulton & Co. is the contractor.



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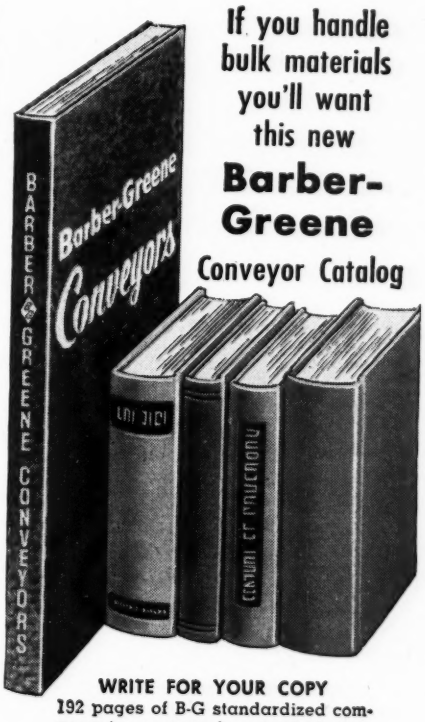

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PENDING CONSTRUCTION

ATLANTIC SEABOARD CORP. and **VIRGINIA GAS TRANSMISSION CORP.**, Charleston, W. Va. Docket G-2062 for two compressor stations totaling 10,560 hp.

COLORADO INTERSTATE GAS CO., Colorado Springs. Docket G-2120 (1953 program) 49 miles of 20-in. loop line on line near Denver; 30 miles of 12-in. to connect 20-in. with Morton county, Kan. compressor station; 24,860 hp compressor capacity at new and existing stations in Colorado, Oklahoma, Texas, and Kansas. Engineering Construction Co. at work in Kansas.

EAST TENNESSEE NATURAL GAS CO., Knoxville. Docket G-1336 for a 100-mile, 16-in. line from near Knoxville to Kingsport, Tenn. with about 58 miles of various sized lateral lines.

EL PASO NATURAL GAS CO. Docket G-2104 for total of 1056 miles of line to include about 750 miles of 30-in. and 70 miles of 24-in. mainline with related gathering lines, purification facilities and compressor plants totaling 161,860 hp to carry gas from Permian and San Juan basins.

HOME GAS CO., Pittsburgh. Docket G-2059 for 19-mile pipeline in Tioga and Broome counties, N. Y.

IOWA-ILLINOIS GAS & ELECTRIC CO., Davenport. Docket G-2012 for 22 miles of line to connect with Natural Gas Pipeline Co. of America's system in Mahaska county and extend to a point in Ottumwa county, Iowa.

NATURAL GAS CO. OF W. VA., Pittsburgh. Docket G-2059 for 21.3 miles of line and retirement of 14.7 miles in Columbiana county, Ohio.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh, Pa. has let contract to Dravo Corp. to install an 880-hp compressor station in West Bradford township, Chester county, Pa.

NEVADA NATURAL GAS PIPE LINE CO., Las Vegas. Docket G-1888 for 110 miles of 10-in. line from Topock, Ariz. to Whitney, Nev., serving Las Vegas and Henderson areas. Contract let to R. H. Fulton Co., Lubbock, Texas. Construction scheduled to start in September.

PACIFIC GAS & ELECTRIC CO., San Francisco. Docket G-2102 to build about 220 miles of 34-in. mainline loops and 2500 hp in compressor capacity on line from Topock, Ariz. to a point near Milpitas, Calif.; and 6.5 miles of line between Milpitas and Irvington, Calif.

SOUTHEAST ALABAMA GAS DIST., Birmingham. A "U" shaped system of about 330 miles to serve 24 communities in southeastern Alabama from connections with Southern Natural.

SOUTHERN CALIFORNIA GAS CO. and **SOUTHERN COUNTIES GAS CO.**, Los Angeles. Docket G-2104 to build about 73 miles of 30-in. mainline loops and 5280 hp in additional compressor capacity at Blythe on existing line extending from Blythe to Santa Fe Springs, Calif. Work to begin first of October.

SOUTH CAROLINA NATURAL GAS CO., Columbia, S. C. Docket G-1961 for a 160-mile pipeline in Aiken, Lexington, Richland, Orangeburg, Dorchester, Charleston and Berkeley counties, S. C. Right-of-way being purchased.

UNITED FUEL GAS CO., Charleston. Docket G-2061 for 50.5 miles of 20- and 24-in. line from new 3300-hp compressor station at existing storage pool in Wood county to Lanham station in Putnam county, W. Va. Also acquisition of leaseholds and authority to drill wells, install well and field lines for new storage pool. Additional 18 miles of line and 3300-hp compressor station approved.

APPROVED

SOUTHERN COUNTIES GAS CO., Los Angeles. Docket G-2182 for 14 miles of 24- and 22-in. pipe from connection with Blythe-Santa Fe Springs line near Brea to Santa Ana. Hood Construction at work. Completion expected Nov. 15.